SEPTEMBER 19, 1960

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Chemical Engineering

A McGRAW-HILL PUBLICATION

AUTOMATIC CONTROL: On-the-spot coverage of the Moscow conference — p. 181

EVOLUTIONARY OPERATIONS: New way to optimize chemical processes — p. 193

SWIVEL JOINTS: When and how to use these kinkproof connections — p. 175

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A processor replaced a battery of plate and frame filter presses with two EimcoBelt filters for dewatering corn grits — with these results:

- **The EimcoBelt filters handle this sticky, high-protein slurry continuously, with no blinding . . . no fall-off in rate.**
- **With about one-tenth of the filtration area, the EimcoBelts produce at eleven times the rate of the plate and frames.**
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These big gains in performance and lower costs were made filtering a slurry that had never been filtered before, successfully, on vacuum filters!

Corn grits is only one of several difficult, hard-to-filter slurries now being filtered continuously and profitably on EimcoBelt continuous belt drum filters.

The Eimco representative near you can give you complete facts on the new EimcoBelt filter — Eimco's greatest contribution to the science of filtration. Write Eimco Filter Division for new EimcoBelt Bulletin F-2053.

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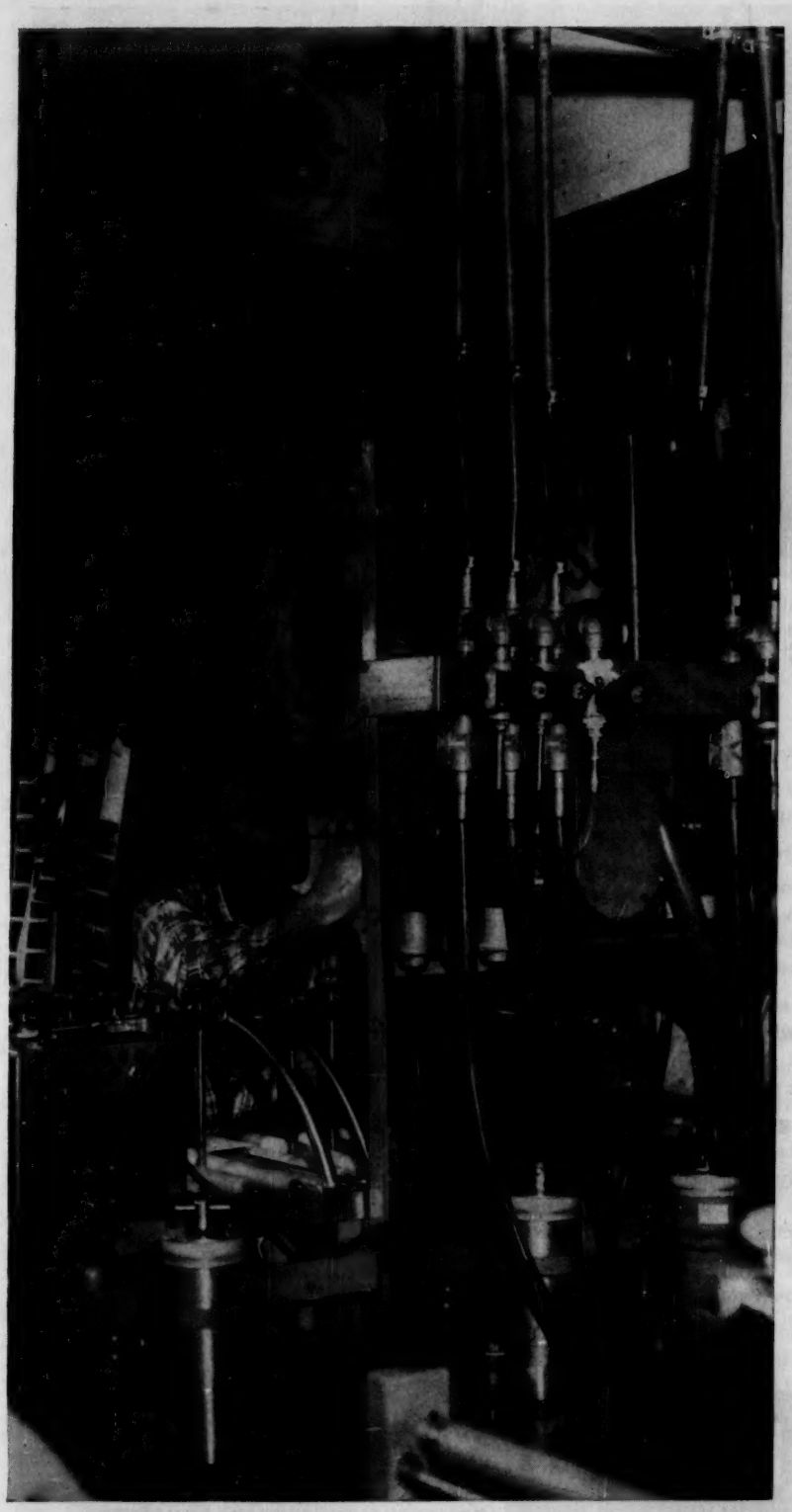


Koroseal defeats corrosion in a photo finish

THIS photo-finishing company uses an intricate piping system to feed chemicals to color processing machines. But the chemicals are highly corrosive—so strong they ate holes in metal pipe. The leaks were costly to repair, slowed production, sometimes brought it to a standstill at the peak of a busy period. Metal pipe was being replaced frequently.

When a B.F.Goodrich distributor heard of the problem, he recommended installing pipe, fittings and valves made of Koroseal PVC. It doesn't corrode. It's unaffected by most alkalies, acids, salt, alcohol and oil. Koroseal pipe does not react chemically, will not contaminate liquids.

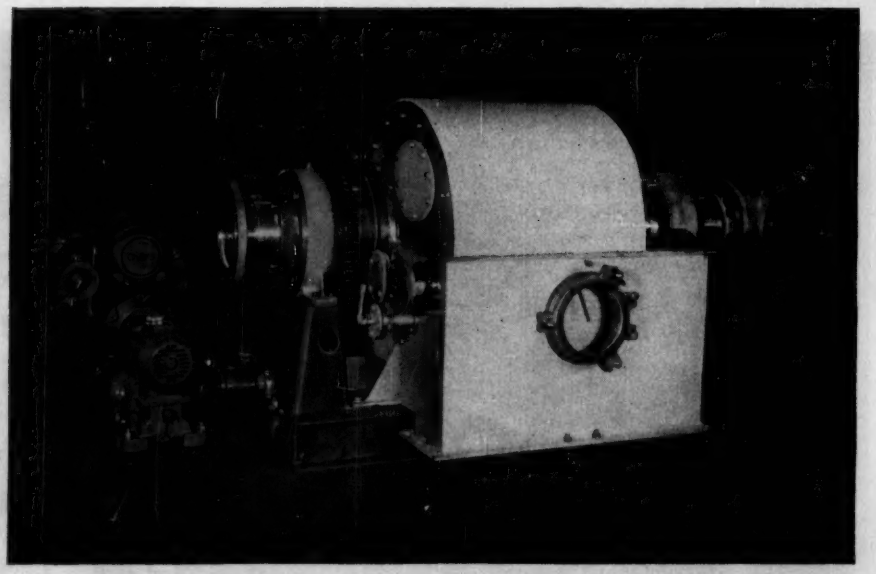
In the picture, you see only a small part of the 3000-foot Koroseal installation—now in its fifth year of trouble-free operation. There's been no contamination, no discoloration of chemicals or film, no costly downtime.

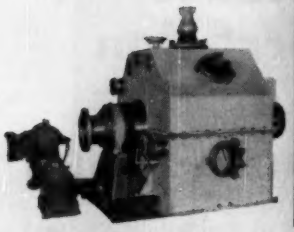
More and more companies are finding Koroseal PVC pipe ideal for use wherever chemical resistance, high working pressures, good impact resistance are factors. Longer service life and low installation costs make rigid Koroseal competitive with metal piping.

For the full story on Koroseal's many advantages, get in touch with a BFG distributor or send for a free booklet. *B.F.Goodrich Industrial Products Co., Dept. M-914, Akron 18, Ohio.*

Koroseal—T. M. Reg. U. S. Pat. Off

Koroseal rigid PVC products by B.F.Goodrich





The Bird-Young Filter is readily equipped for totally enclosed, tightly sealed operation.

This small BIRD-YOUNG Vacuum Filter does a giant's job

Because throughput of solids per foot of filter area may be *many times* that of ordinary drum filters, the Bird-Young Vacuum Filter often effects big savings.

For example:

Two small Bird-Young Filters replaced three big filters. What the processor was looking for was a low wash ratio and he found it in the Bird-Young. He also discovered that its ability to filter thin cakes at high speed required only a fraction of the filter area to do the job.

Small enough to meet stringent safety requirements. A radioactive slurry outlawed use of big filters and it looked like expensive multiple units until they discovered that the Bird-Young Filter provided both the capacity and the small size to meet safety tolerances.

Many good things come out of a smaller package. The producer of a polymer found he could put through three times as much solids per foot of filter area while virtually eliminating a serious problem of blinding filter cloths, increasing his cake dryness and greatly improving his washing efficiency. Product purity has stepped up as much as fifty per cent with no increase in wash ratio.

This is why we urge you to investigate the Bird-Young Filter before you buy any vacuum filter.

The Bird Research and Development Center is equipped to develop the facts and figures in advance of your investment.

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Chemical Engineering

September 19, 1960

CHEMICAL TECHNOLOGY FOR PROFIT-MINDED ENGINEERS

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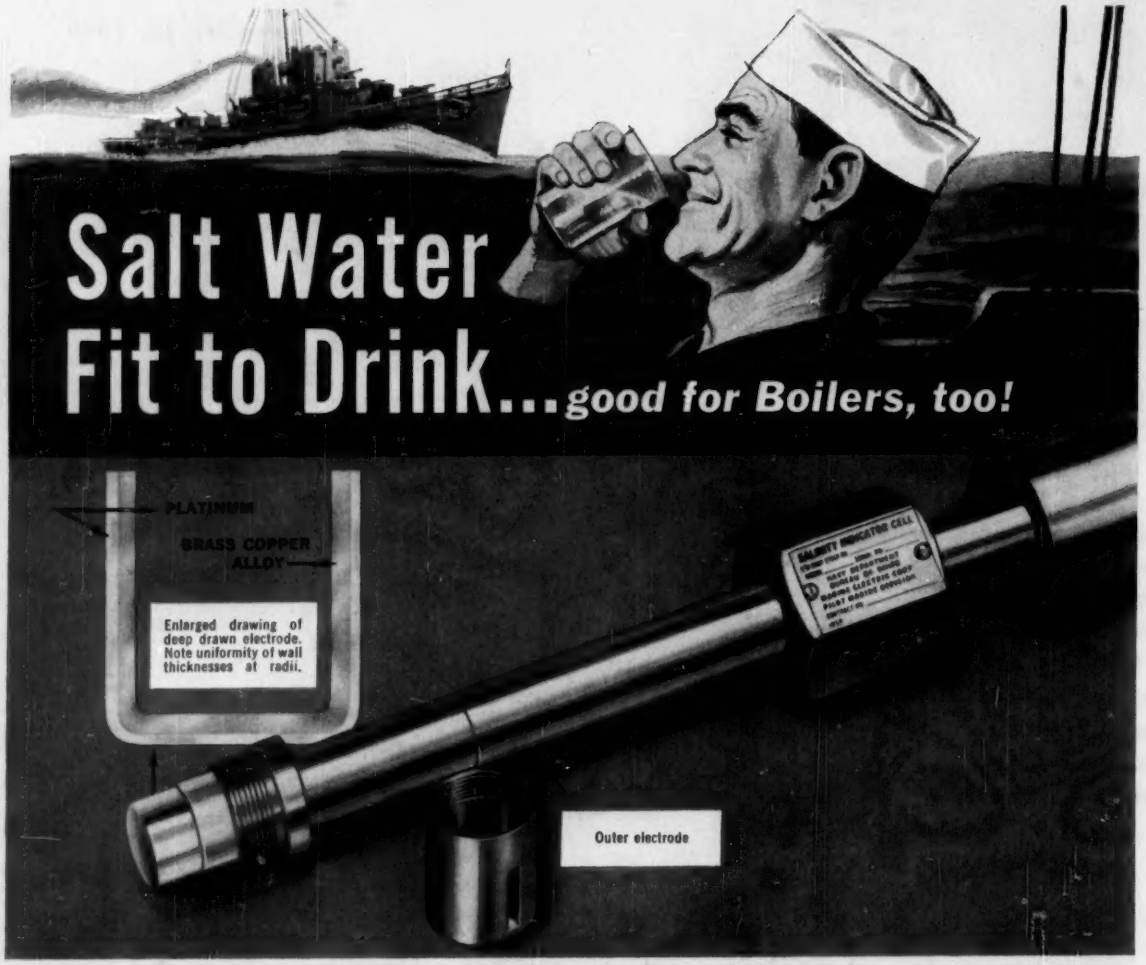
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Fit to Drink...good for Boilers, too!
PLATINUM
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Enlarged drawing of deep drawn electrode. Note uniformity of wall thicknesses at radii.
Outer electrode

General Plate Platinum Clad Electrodes Help Conductivity Cell Measure Water Impurities

Assure Constant Performance ...Reduce Costs

The operating principle of the Pilot Marine Salinity Indicating System is based upon the measurement of the electrical conductivity of water which is determined by salinity and temperature.

Materials originally used as electrodes in the cell did not meet performance requirements. For instance . . . silver, tin, nickel and palladium corroded or were consumed too rapidly . . . in platinum electroplated electrodes, the platinum wore off too rapidly, and the other metals had a tendency to polarize, skewing indicator panel readings . . . solid platinum sleeve, inserted in a casing of base metal and outer layer drawn to size of platinum sleeve, collapsed under high temperature and pressure.

Pilot Marine Engineers turned to the General Plate Products group of Metals & Controls division for a solution to the problems involved in electrodes used on the conductivity cell.

General Plate Platinum clad P-20 (brass-copper alloy) drawn into a cup shape and matching piece in the form of tubing, as fabricated by General Plate, met all the performance requirements . . . reduced costs, too.

General Plate Platinum-Group Clad Metals, and fabrication facilities offer users greater savings in present applications, as well as new uses. Typical uses include linings for vessels, electrical contacts, rupture discs, electrodes, anodes and laboratory ware. Bulletin PLA-1 gives full details. Write for your copy.

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highlights of this issue

OPTIMIZE WITH EVOLUTIONARY OPERATIONS

Do you hesitate to tinker with a production unit, even though you suspect that certain changes will improve operations? Then you should use the EVOP technique. J. S. Hunter, of the famed Box-Hunter team, shows how (p. 193).

MOSCOW CONTROL CONFERENCE

Our man in Moscow, Ernest Conine, reports (p. 181) his on-the-spot impressions of the First Congress of International Federation of Automatic Control. Dave Boyd, UOP's top instrumentation expert and only Western delegate allowed to visit a process plant, fills in with additional details.

SWEET-GAS PROCESS MAKES U. S. DEBUT

First plant in the Western Hemisphere to treat natural gas by the highly touted Giammarco-Vetrocoke process is now on stream in Texas. Process Flowsheet (p. 166) describes Transwestern Pipeline Co.'s 180-million-cfd. installation, built by Brown & Root.

INDUSTRY NEWS, CPI BRIEFS

Names have been changed, not to protect the innocent but to reflect more accurately the scope of these news departments. Industry News (p. 92) is the banner under which we report significant developments in those areas of business and technology of most interest to engineers and technical managers. It used to go by the name Processes & Technology.

What has recently been called Industry News and, for many years previous, Firms in the News, now will be known as CPI Briefs (p. 102). CPI is our abbreviated way of designating that broad segment of the industrial economy known as the chemical process industries.

MOBIL HELPS CHARDON RUBBER

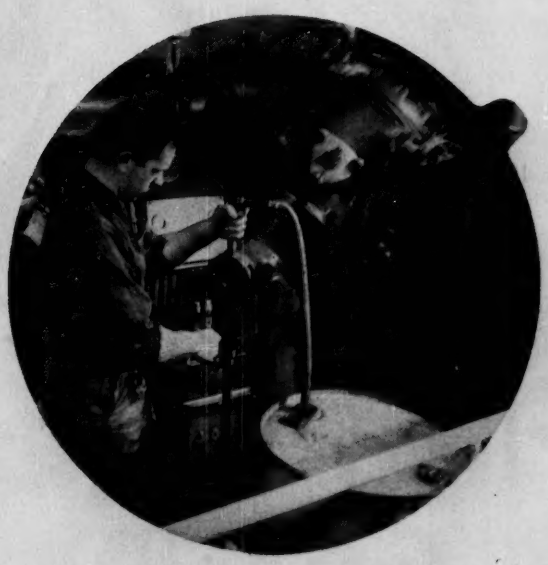
Oil life extended, lubrication costs slashed, maintenance techniques improved, equipment downtime reduced—average annual savings over four-year period: $6,928.

The Chardon Rubber Company produces a wide variety of specialty items for industry. These items include thousands of precision-molded and -extruded rubber and plastic pieces of various shapes.

Quality control and accuracy are of prime importance at Chardon. And to maintain high level production and equipment performance, Chardon relies on Mobil lubricants and Mobil technical assistance. By suggesting oil re-use, by extending lubricant life, by recommending correct products and improved application techniques, Mobil has helped Chardon *save twice as much in maintenance costs as they have spent on Mobil Products.*

Interested in how Mobil may benefit you? Call your Mobil Representative. Or write: Mobil Oil Company, 150 East 42nd Street, New York 17, N. Y.

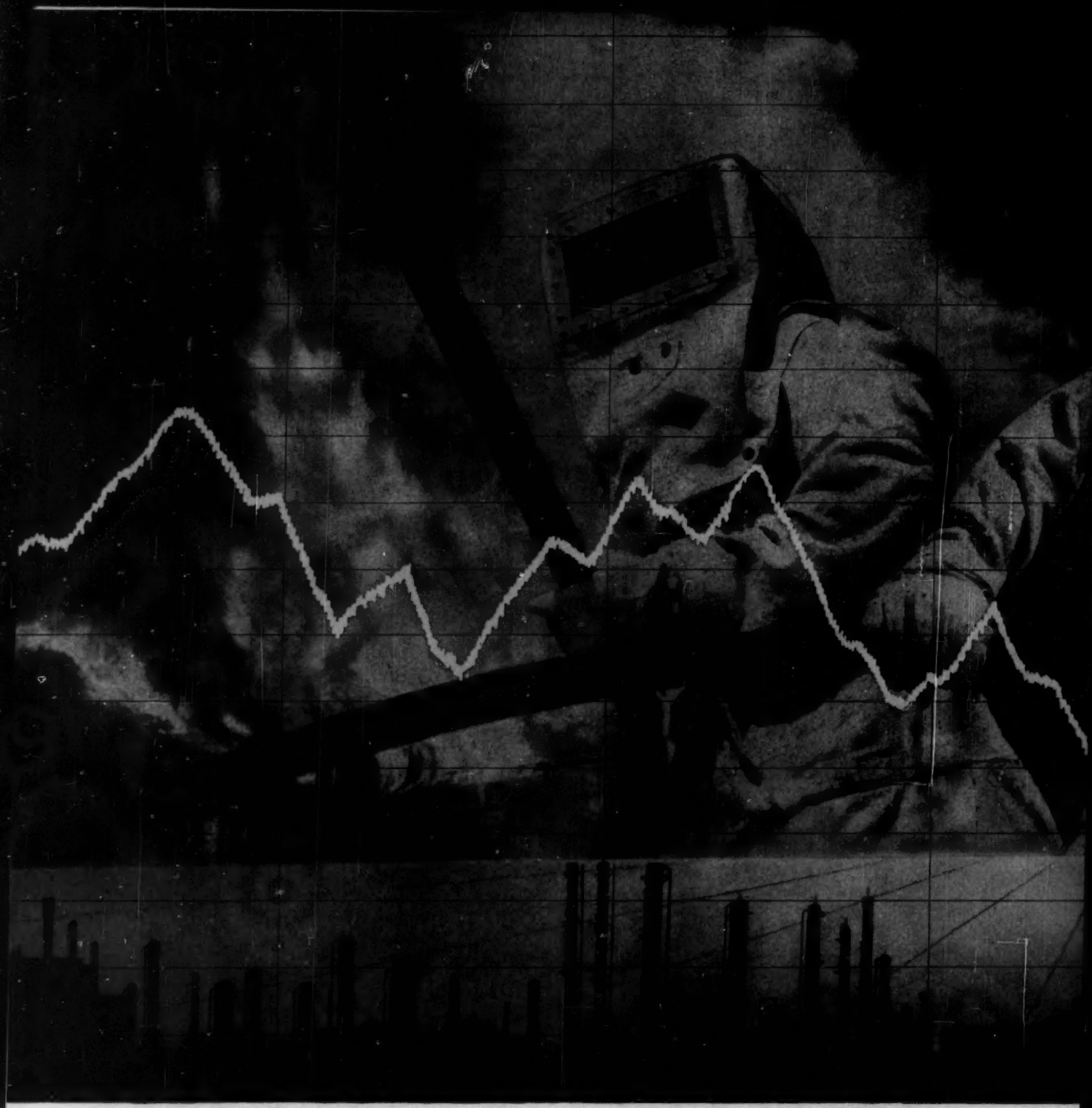
SHAPE $27,713 SAVINGS!



SAVED: $1,600. With excessive carbon build-up causing faulty valve seating and an explosion hazard in three air compressors at Chardon, these compressors had to be opened up for valve cleaning or replacement an average of 10 times a year collectively. Mobil recommended correct cylinder lubricant and proper feed rates. Result: compressors have run over 4 years without overhaul.

SAVED: $938. Chardon Rubber encountered these problems in 42 molding presses: damaged packings, gasket failures, leaking valves and rusted rams and cylinder walls. By changing the hydraulic fluid formulation, Mobil has reduced these problems materially—saved Chardon $938 in 18 months.

Mobil **CORRECT LUBRICATION**



Celanese chemicals make heat

From Celanese research come the chemical answers to industry's critical problems of high-temperature application. By eliminating many of the basic hazards of heat and fire, Celanese is contributing to the safety of industry.

Synthetic chemicals by Celanese help protect against extreme loss by fire or explosion. They include Cellulubes, fire resistant lubricants and hydraulic fluids . . . Cellutherms, for jet engine-temperature applications . . . fire resistant plasticizers . . . fire retardant additives for paints and varnishes. Celanese research has contributed substantially toward conquering the problems of fire and heat in industry. A pioneer in fire-resistant fluids and chemicals, Celanese has years of experience to put to work to make your plant or application safer, more efficient. For more details, please write to us, outlining your specific interest. Celanese Chemical Company, a Division of Celanese Corporation of America, Dept. 553-S, 180 Madison Avenue, New York 16, N. Y.

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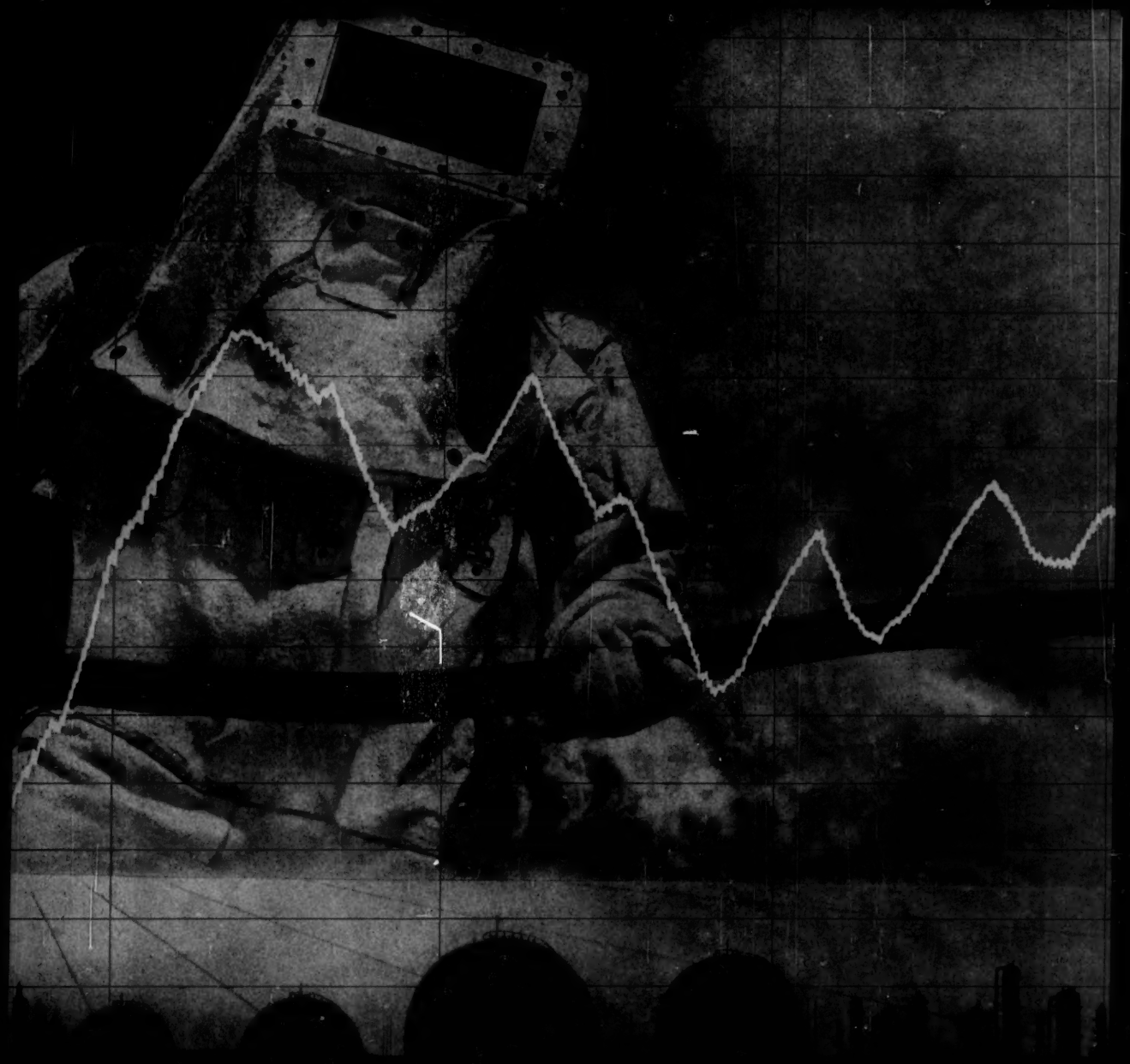
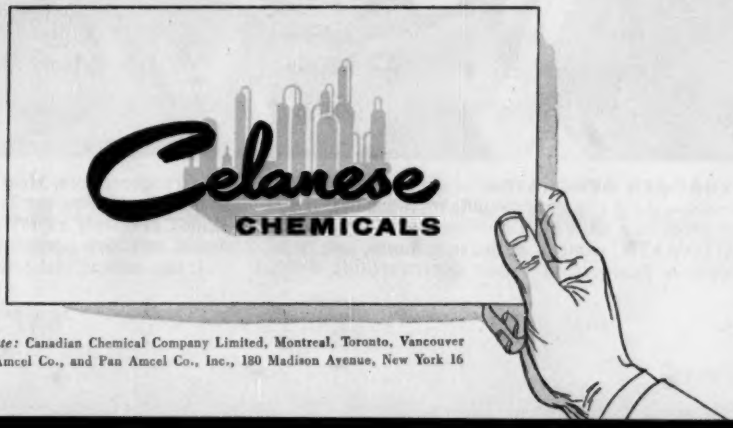


and combustion behave...



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HYDROGEN GENERATOR – Comprised of NORELCO Cryogenerators, Heat Exchanger, Purifier and Gas Compressor – these units are capable of capacities to 10,000 standard cubic feet per hour. A UNIQUELY designed system for producing ultra pure hydrogen with a minimum of skilled operating supervision. IDEAL for on-site generation! AUTOMATIC controls insure continuous, safe, reliable service and high purity product. This continuous and oil-free supply is produced at a cost approximating one-half (½) the commercial purchase price.

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The new NORELCO process produces pure hydrogen from disassociated ammonia gas by low temperature condensation of nitrogen followed by low temperature adsorption. The product produced contains less than 50 parts per million nitrogen impurity.

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Hydrogen purity is monitored by a hydrogen analyzer so as to re-cycle gas not meeting product specifications. The gaseous product is available at pressure for storage or direct process use.

Facilities for research, design, and fabrication are available at the Norelco Cryogenics Application Laboratory for any industrial problem involving low temperature application. Complete technical information may be obtained by writing to us today.

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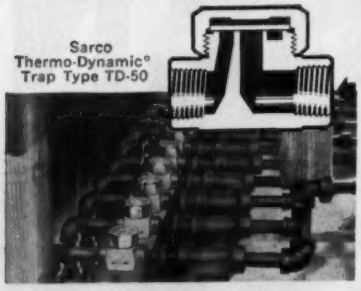
SARCO

NOW... MATCH STEAM TRAPS

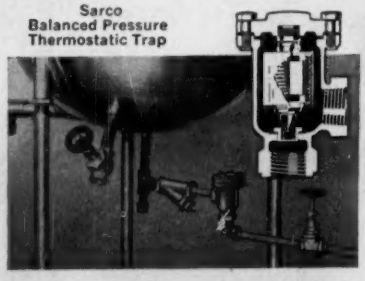
THERE'S no such thing as an all-purpose steam trap. That's why it pays to know what each trap has to offer. Here are five examples that demonstrate how you can match the correct steam trap type to the exact requirements of *each* application.



EXAMPLE 1: Outside Tracer Lines: A tough set of requirements

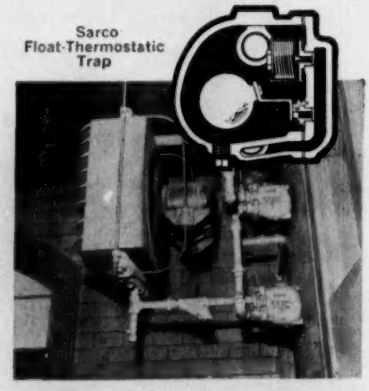
One of the most demanding sets of requirements a steam trap has to face is found in *outside steam tracing*. The trap must not only rid tracer lines of condensate and air immediately they're formed, but it must do so under exacting conditions. Pressures on each trap may vary widely. Installations may be remote and inaccessible to service. Water hammer may be a constant threat; freezing may be a hazard. Only the unique Thermo-Dynamic trap takes all these demands in stride. The Sarco TD-50 operates perfectly *without adjustment* through its full pressure range of 10-600 psi. It's virtually immune to water hammer and won't freeze when installed with a free discharge. Maintenance is, therefore, negligible. Compact, requiring no external support, the TD-50 is just about the easiest trap in the world to install. Once it's installed, you can forget it. You can count on an extremely long, trouble-free service life with minimum maintenance attention.

More closely than any other model, the TD-50 approximates an all-purpose trap. However, special application requirements might dictate the use of another type of Sarco trap. Sarco engineers stand ready to help you solve any trapping problems.



EXAMPLE 2: For steam jacketed process kettles: a trap that operates immediately on start-up and self adjusts to both low and high pressures

When a large steam-jacketed process kettle starts up, the condensate load is high, and all air in the jacket must be released quickly. At this stage, however, the jacket pressure is low; yet it builds up rapidly as the process continues. Because a SARCO No. 9 Balanced Pressure Thermostatic Trap is wide open on start-up, it releases initial air and condensate without the need for a bypass. And because it is self-adjusting, it works just as efficiently during the first processing stage when the jacket pressure is high. There are no seats to change for various working pressures. You can see why it is the obvious choice for steam jacketed process kettles.



EXAMPLE 3: How to prevent water-logging in unit heaters and blast coils

All unit heaters and blast coils have a relatively small internal volume in comparison with their steam condensing capacity. Even slight water-logging can reduce heat output seri-

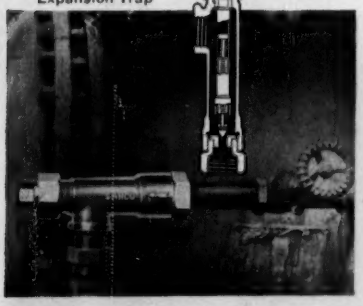
Impartial advice on trapping because
ONLY SARCO MAKES ALL 5 STEAM TRAP TYPES

TOPICS

TO YOUR TRAPPING NEEDS

ously. Pressures may vary widely under automatic temperature control and so may the load because of variable demand. A trap to handle this application must adjust itself instantly to pressure and load charges. The most precise answer to this problem is the SARCO Float and Thermostatic Trap—and here's why: it releases air on start-up and during running, and, because it discharges condensate continuously, it does not set up in the system violent pressure changes that would upset close control.

Sarco Liquid Expansion Trap



EXAMPLE 4: How to release low temperature condensate

When condensate cannot be returned to the boiler feed tank either because of distance or because it may be contaminated, it's economical to utilize some of the sensible heat as well as the latent heat of the steam.

For this purpose a trap must be capable of releasing condensate to temperatures as low as 100° F.

The sound trap selection here is the SARCO No. 871 Liquid Expansion Trap because it can be set to release condensate at temperatures down to 100° F. regardless of supply pressure. This performance assures maximum steam economy. The Sarco No. 871 handles the starting load easily because of its wide open valve, which throttles the flow as the condensate temperature rises. Furthermore waterhammer cannot reach the operating element. No other type is as nearly perfect for this specific problem.

Sarco Bucket Trap

EXAMPLE 5: Economic handling of Water Hammer and Corrosive Conditions

In applications in which water hammer or corrosive conditions are encountered but in which low pressures or extremely high back pressures preclude the use of the Thermo-Dynamic trap, the Sarco Inverted Bucket Trap is recommended. While the Sarco I. B. is not exactly a fuel miser, its relatively rugged construction will withstand considerable water hammer; and, when it is fitted with stainless steel internal parts, it offers excellent resistance to corrosion.

* * *

CONCLUSION: The right application is the economical installation

When you choose steam traps that serve their purpose without frequent adjustment, and without maintenance or replacement problems, you save on down-time, man-hours, spare parts, and production slowdowns.

You can get the money-saving solution to every trap selection problem by consulting Sarco. You get impartial solutions, because only Sarco makes all 5 types of steam traps: Thermo-Dynamic*, Thermostatic, Float Thermostatic, Liquid Expansion, and Bucket.

You also get the benefit of Sarco's 50 years of specialized experience in the manufacture and application of temperature regulators, industrial air vents, pipeline strainers, dial and industrial thermometers, heating and cooling controls, heat exchangers, heating control systems and heating specialties.

For literature or impartial help in solving your steam trapping or control problems, contact your local Sarco Sales Representative, or write direct to Sarco. 1440

*U.S. Pat. No. 2,817,353. T.M. Reg. U.S. Pat. Off.

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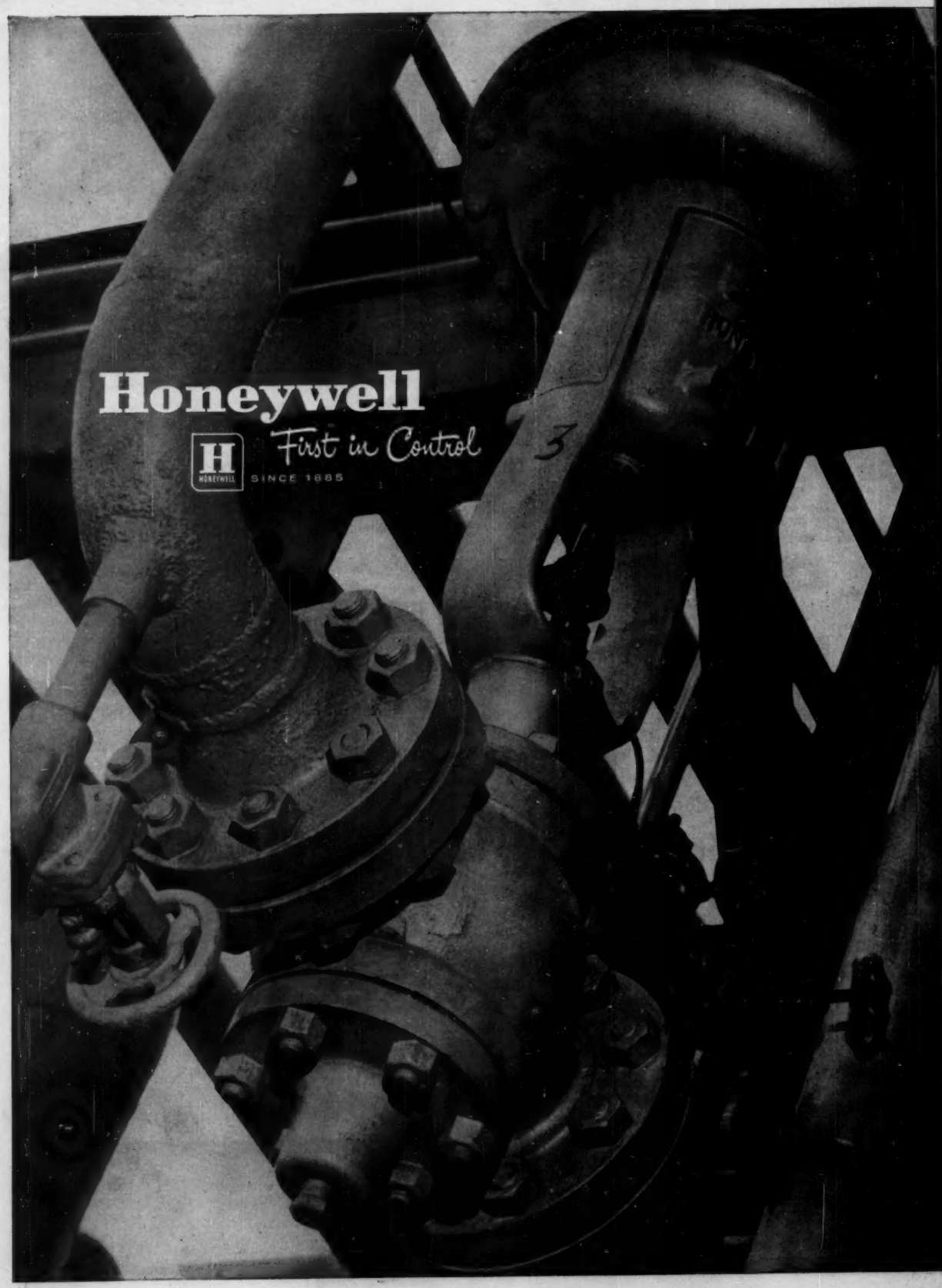
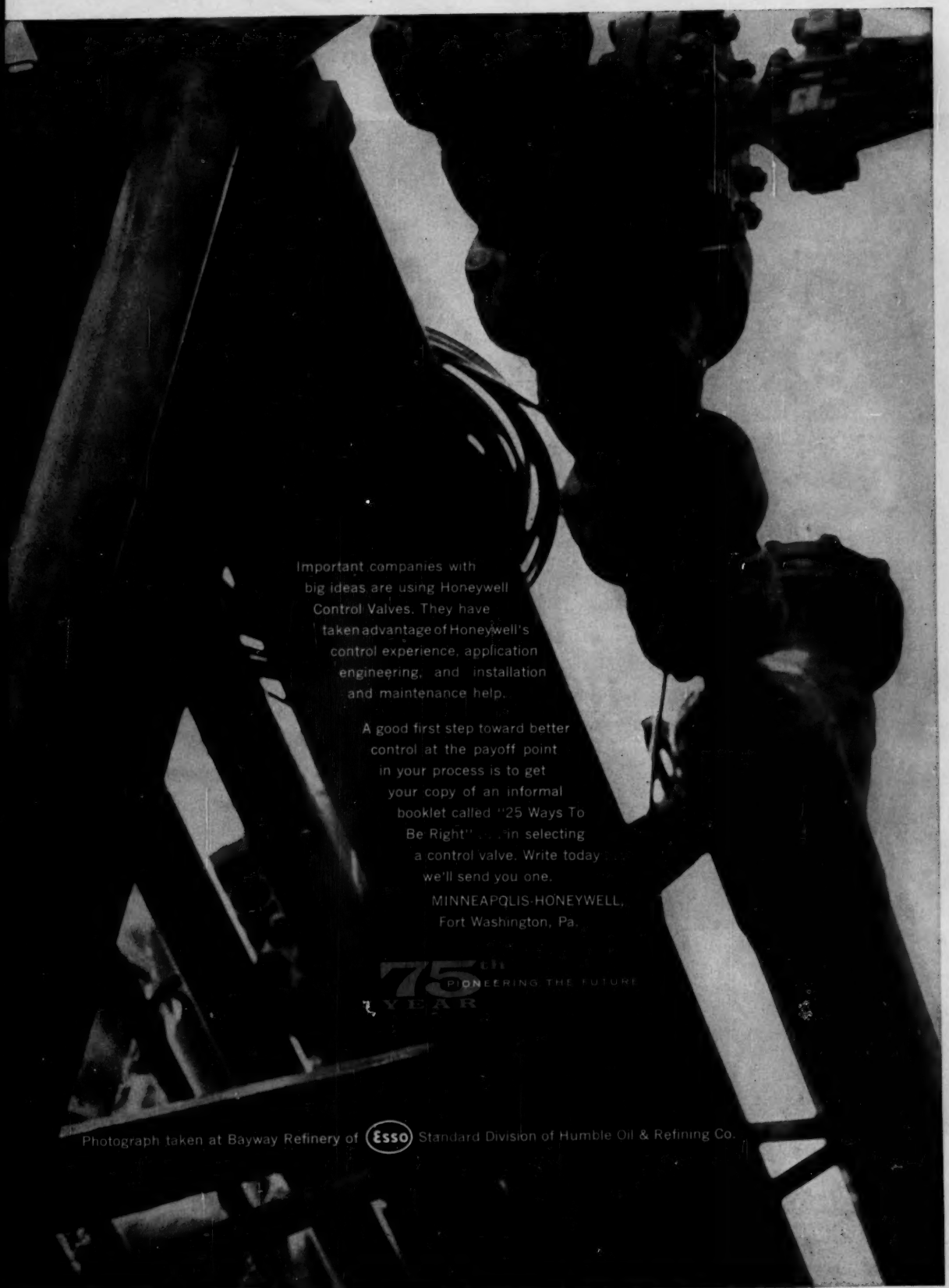
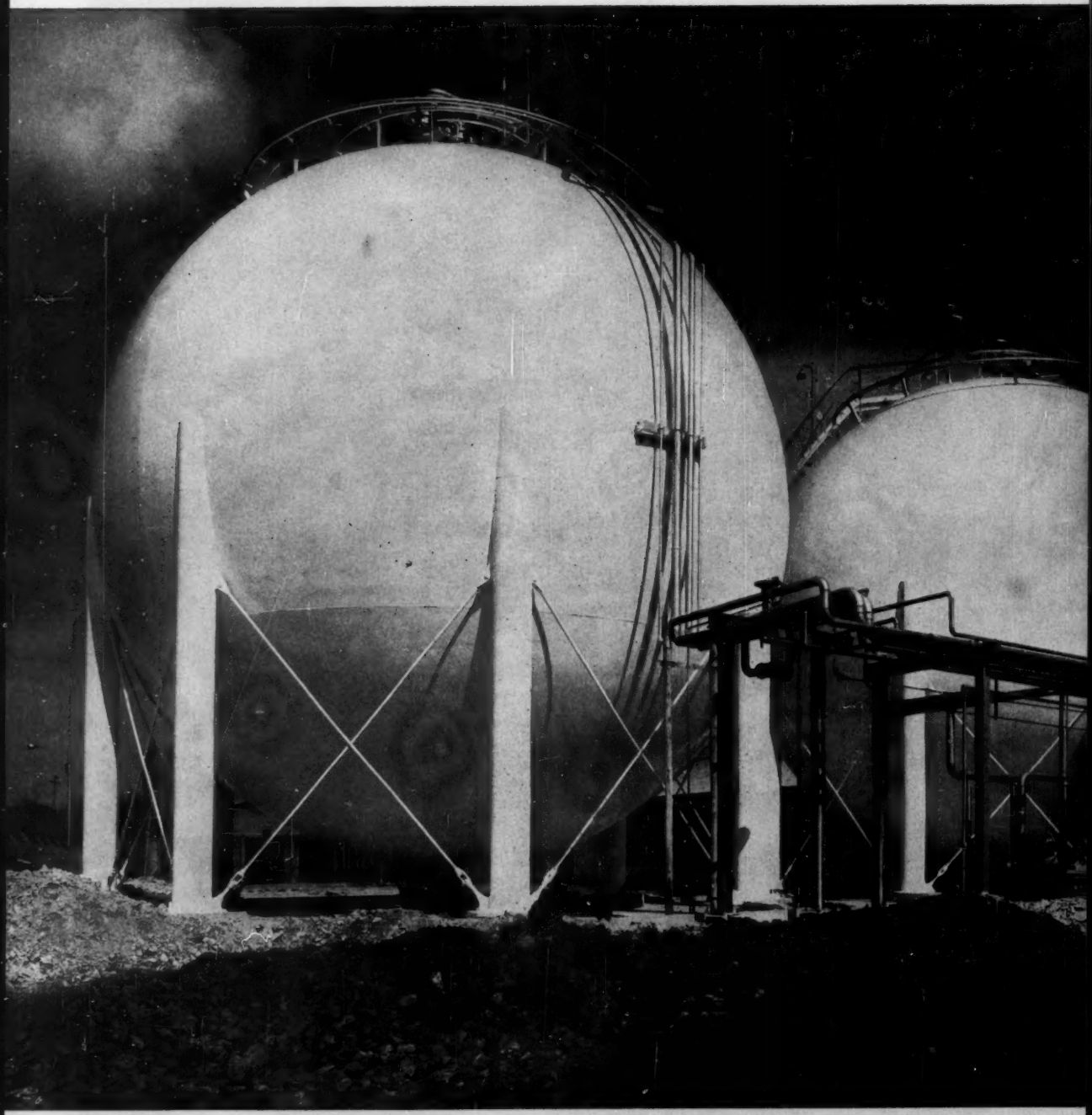

Honeywell
First in Control
SINCE 1885


Important companies with big ideas are using Honeywell Control Valves. They have taken advantage of Honeywell's control experience, application engineering, and installation and maintenance help.
A good first step toward better control at the payoff point in your process is to get your copy of an informal booklet called "25 Ways To Be Right" in selecting a control valve. Write today we'll send you one.
MINNEAPOLIS-HONEYWELL, Fort Washington, Pa.
75th YEAR
PIONEERING THE FUTURE
Photograph taken at Bayway Refinery of Esso Standard Division of Humble Oil & Refining Co.



Hortonspheres built of USS "T-1" Steel for Compania Cubana Del Nitrogeno, S. A., Matanzas, Cuba. Designed, fabricated and erected by Chicago Bridge & Iron Company.

This mark tells you a product is made of modern Steel.

Weight cut 50%

in USS "T-1" Steel pressure vessels

Each of these two Hortonspheres in Matanzas, Cuba, has a capacity of 8,750 barrels of anhydrous ammonia. They are 45.5 feet in diameter and each shell weighs about 311,350 pounds. By designing them with USS "T-1" Constructional Alloy Steel, to an allowable working stress of 32,400 psi, the plate thicknesses were reduced to 1.109 inches and 1.075 inches. This is about 50% less than if A212-Grade B fire box quality steel had been used.

Result: Only 363 tons of USS "T-1" Steel were needed for both tanks, reducing by one-half the amount of steel that would otherwise have been required. Freight, handling, welding and erection costs were less—and the user got a stronger, tougher vessel with an overall saving in cost.

Fabrication steps: Plates of USS "T-1" Steel in widths of 78 inches and 115 inches, and in lengths up to 19 feet 2-1/2 inches, were shaped cold and field stress relieved. Column plates and some shell plates were stress relieved in the shop. Electrodes used in field welding were low hydrogen type of the E110 strength level and all field welds were 100% radiographed. With a minimum yield strength of 100,000 psi, plus toughness, weldability, and high resistance to impact abrasion, USS "T-1" Steel is ideally suited for many applications throughout industry. Write for our latest booklet. United States Steel, 525 William Penn Place, Pittsburgh 30, Pennsylvania. *USS and "T-1" are registered trademarks*

Hortonsphere is a registered trademark of Chicago Bridge & Iron Company

United States Steel Corporation—Pittsburgh
Columbia-Geneva Steel—San Francisco
National Tube—Pittsburgh
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United States Steel Supply—Steel Service Centers
United States Steel Export Company
United States Steel

USS

What makes **TRANSCOPE®**

Electronic and Pneumatic Recorders

the most wanted miniature instruments on the market today?

. . . The answer is **SERVO**

In the past 2 years thousands of Servomatic motors have proven the inherent advantages of this Taylor innovation. Heart of the 90J (pneumatic) and 700J (electronic) recorders, it puts TRANSCOPE Recorders in a class by themselves. It is the most reliable device yet developed for converting an input signal into an accurate record. The tremendous power of these Servomatic motors—150 times greater than the bellows type (pneumatic), over 1,000 times greater than galvanometer systems (electronic)—gives you all these advantages:

- Greater accuracy than ever before—½ of 1% in standard instruments, ¼ of 1% optional.
- Threshold sensitivity of 0.1% to input signal.
- 3 months' ink supply mounted on the pen—no troublesome capillary.
- Lifetime recording accuracy—no critical pen pressure.
- No flimsy linkages and levers.
- Truly rectilinear chart—no curved time lines.

Plus these optional features: alarm contacts—retransmitting potentiometer—function generation—digital output with encoder discs.

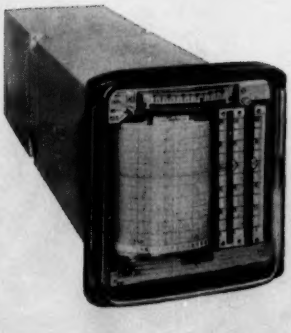
* * *

Ask your Taylor Field Engineer for full details of all the many superior features of TRANSCOPE servo-operated recorders. Or write for Bulletin 98286 (pneumatic) or 98335 (electronic). Taylor Instrument Companies, Rochester, New York, or Toronto, Ontario.

See it demonstrated at the ISA Show, Booths 1432-36; 1531-35

700J (electronic) servo motor is 2 phase, size 15, 60 cycle, 117 volt—built to military specifications.

POWER



Other TRANSCOPE advantages:

- Unconfused readability—because chart record, pen and set-point are side-by-side.
- 4″ chart reads from left to right—on rectilinear coordinates.
- Controller response adjustments may be made from the front—you can watch the results.
- Separate Plug-in Set Point Transmitters permit staying on automatic control—even when recorder slide is removed.
- All principal assemblies are plug-in mounted for flexibility and accessibility.
- Plug-in recorders and controllers permit housings to be shipped 4-6 weeks earlier than completed instruments to enable you to make all necessary connections to tagged manifolds.

Recorders of the future will have SERVO POWER . . . TAYLOR has it NOW!

Taylor Instruments **MEAN ACCURACY FIRST**

CONVEYOR SYSTEMS 1600 MI. APART SPEED ORE SHIPMENTS TO U.S.

Specially designed Barber-Greene system utilizing unique hinged arch-type supports mechanizes shipping terminal for U.S. Steel subsidiary

Two Barber-Greene conveyor systems, located 1600 miles apart in South America, help speed manganese ore from a Brazilian mine to a shipping terminal in Uruguay where the ore is loaded into ships for delivery to U.S. steel mills.

The shipping terminal is operated by Compania Navigen Sucursal Uruguaya, a U.S. Steel subsidiary, and began operation in 1958.

Navigen Company officials say, "The Barber-Greene conveyor equipment at the Transfer Station has operated very satisfactorily and was well chosen." Navigen's Technical Director at Nueva Palmyra during installation reports: "Barber-Greene factory assembled terminals were a great help in erection, particularly due to the scarcity of skilled labor. And we got needed technical and engineering support from Barber-Greene personnel from initial planning through erection and operational stages."

Three conveyors at mine

The mine installation at Corumba, Brazil, operated under contract with another U.S. Steel subsidiary, consists of two tunnel conveyors plus a third barge loading boom conveyor that extends out over the river and is adjustable to river levels and barge heights.

At the shipping terminal at Nueva Palmyra, Uruguay, six Barber-Greene conveyors totalling 2,655' unload barges, stockpile the ore and reclaim it for loading into ocean-going vessels. Stockpiling capacity totals 75,000 tons.

Design features

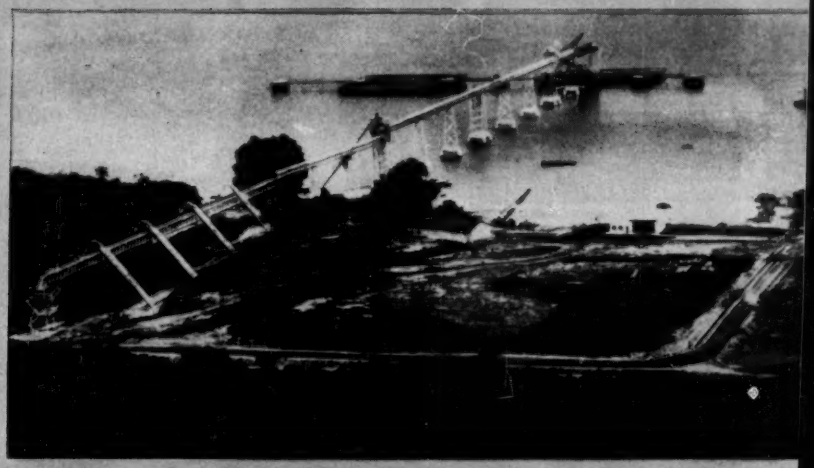
Unique design features: Giant hurricane-proof cantilevered supports that are clear of the stockpile and under which the stockpiling conveyor is hung; reversible belt on the longest conveyor in the system which permits use of the same conveyor for both stockpiling and reclamation operations; run-around system that allows ore to be moved directly from barges to ships when stockpiling is not necessary; and a cantilevered ship loading shuttle conveyor that can be positioned to handle ships of various widths.

The same engineering skill that designed this heavy-duty system to handle 156 lbs./cu. ft. manganese ore is ready to work for you, or your engineering firm. Your Barber-Greene conveyor specialist will gladly explain how standardized or specially engineered systems, or a combination of both, can bring increased efficiency, dependability and lower costs to your material handling problem.

View of inclined conveyor used to reclaim ore from stockpile at Nueva Palmyra. All belts in system are 30" wide and run at average 350 fpm speed. Some of the nearly 1,000 Barber-Greene heavy-duty roller-bearing idlers with 6" diameter rolls are visible here.

Ore from 75,000 ton stockpile is reclaimed by 515' tunnel conveyor fed by 33 gates. Material moves up inclined conveyor, over 854' reversing conveyor and passes over shuttle conveyor enroute to ore boats.

Overall view of terminal shows how whirly crane used to unload barges, hopper, 42" x 10' Barber-Greene belt feeder and tail end of first inclined conveyor are all located hundreds of feet offshore on a cellular dock.



Upper view of 746' stockpiling conveyor at Nueva Palmyra shows top cantilever supports that resist winds up to 130 mph. Conveyor has traveling tripper that discharges incoming ore onto stockpile.

Send for New Idler Bulletin

New 44-page Idler Bulletin describes the more than 800 units available in the complete Barber-Greene line, tells how their years-ahead features bring longer life and greater economy to every job. Ask for your copy today.

Your belt conveyor equipment headquarters

Representatives in Principal Cities of the World

Barber-Greene BG

Main Office and Plant AURORA, ILLINOIS, U. S. A.
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CONVEYORS • LOADERS • DITCHERS

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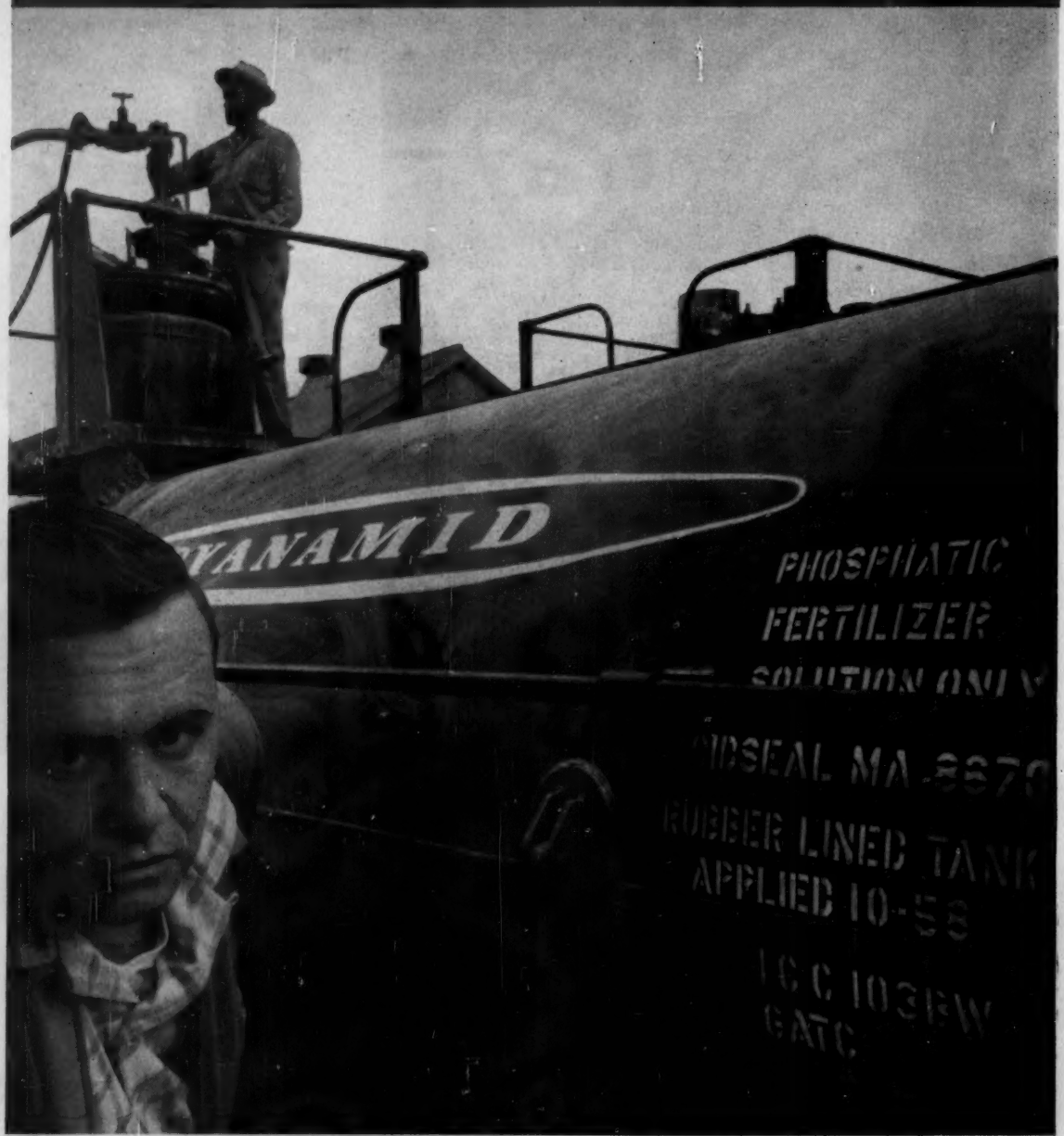
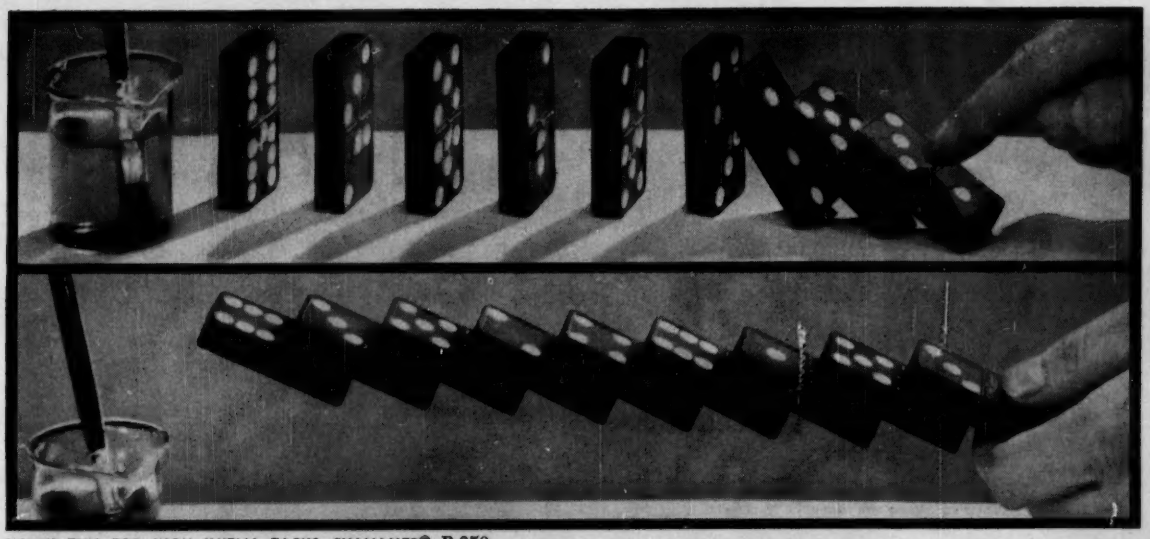
CYANAMID

Chemical Newsfront

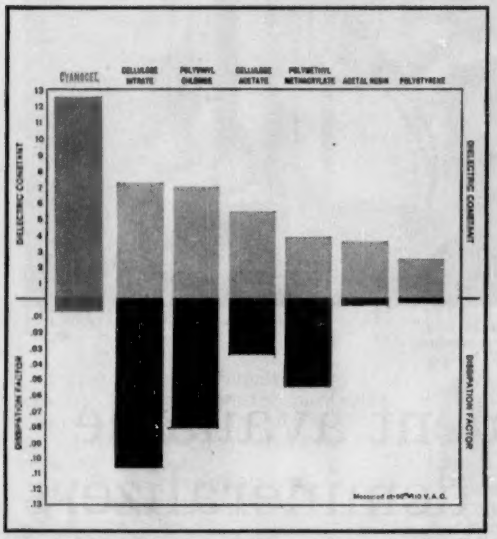


CYANAMID TO DOUBLE PHOSPHORIC ACID PRODUCTION. When a new multi-million dollar addition to its Brewster, Florida plant is completed, Cyanamid will be able to produce approximately 400,000 tons of wet-process 54% phosphoric acid annually. The new facilities will also provide an increased tonnage of triple superphosphate. This increase in the production of these new materials will assure prompt service to Cyanamid customers in all areas served. **(Agricultural Division)**



HOW'S THIS FOR HIGH INITIAL TACK? CYANAMER® P-250 polyacrylamide imparts high initial tack to adhesive formulations. Consider how you could benefit from this feature. CYANAMER P-250 is the highest molecular weight polyacrylamide available, has high thickening capacity, stability over a wide range of pH, and excellent tolerance for electrolytes.

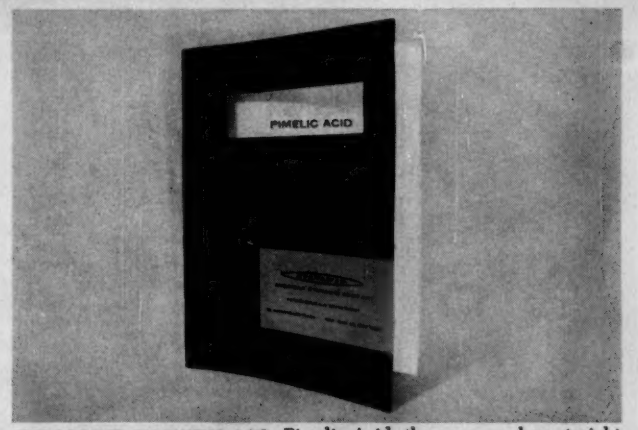
(Market Development)



ELECTRIFYING NEWS! Cyanamid research has developed a chemically modified cellulose with remarkable electrical properties. Trademarked CYANOCEL*, the new product can be cast into film—molded at high temperatures and pressures. Graph (above) demonstrates the unusually high dielectric constant of CYANOCEL and low dissipation factor. Flexibility, physical strength and transparency, combined with outstanding electrical properties, make CYANOCEL particularly interesting to the electrical and electronic fields.

(Petrochemicals Department)

*Trademark



FREE BOOKLET ON PIMELIC ACID. Pimelic Acid, the seven carbon straight chain dibasic acid, is now available from Cyanamid in developmental quantities. This product has the lower melting point and greater solubility characteristic of dibasic acids with odd numbers of carbon atoms. A white crystalline solid, it reacts, for example, to form amides that can be easily dehydrated to nitriles. Pimelic acid should be of particular interest to researchers concerned with polyesters, polyamides and plasticizers. Cyanamid's booklet *"Pimelic Acid"* lists complete properties and potential uses. For your copy check the coupon below. **(Petrochemicals Department)**

For further information on products in this advertisement wire, or mail this coupon to: CE-90

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Please send me additional information on

- ☐ PHOSPHORIC ACID
- ☐ CYANOCEL* Modified Cellulose
- ☐ CYANAMER P-250
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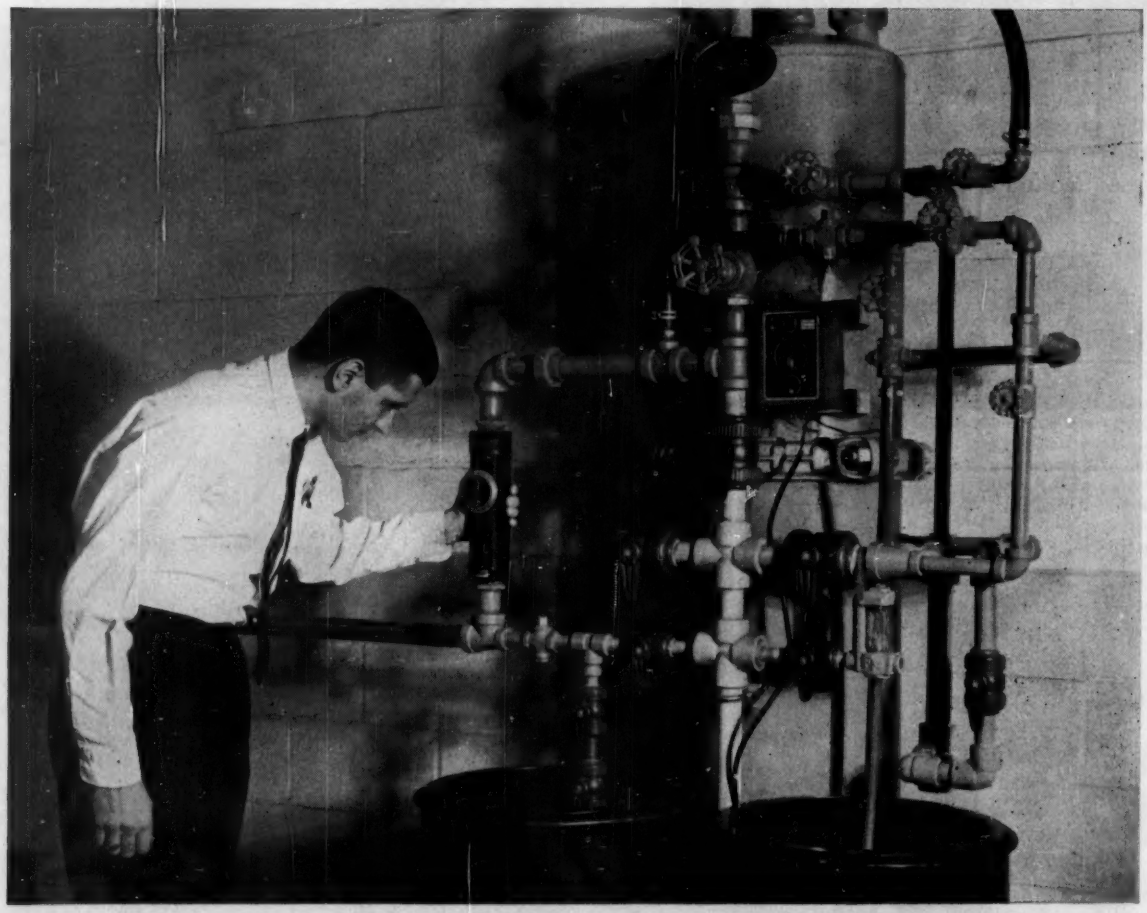
FLUIDICS* AT WORK



MODEL MBD-15A, one of a complete line of "packaged" Permutit ion exchange units, demineralizes 5 to 10 gpm of water to an average conductivity of 0.15 micromhos.

Now! Two-week shipment available on standard Permutit demineralizers

In 14 days, often less, you can now get shipment of standard Permutit ion exchange equipment to demineralize water for your process or production plant. Here are several models on which you can now get this fast, time- and money-saving service.

For 5 to 20 gpm . . .
"packaged" mixed-bed demineralizers

These compact skid-mounted, pre-tested units will demineralize 5 to 20 gpm of water to an average conductivity of 0.15 micromhos (approximately 6,000,000 ohms specific resistance per cm or 0.05 ppm total electrolyte content). CO_2 will be reduced to 0.1 ppm and SiO_2 to about 0.1 ppm. Shipped fully piped, filled with resin, ready to run when you make inlet, outlet and drain connections. Available from stock in four sizes, 12"–15"–20"–24" diameter.

For 10, 20, 30 gpm . . .
three high-volume units

16", 24" and 30"-diameter single-bed units will demineralize 10, 20 and 30 gpm respectively. Like the skid-mounted mixed-bed demineralizers, construction of these units is of the same heavy-weight materials used for Permutit's custom-designed equipment. This includes rugged PVC plastic interior piping and plastic strainers. Steel shells are lined with ⅛"-thick PVC plastisol, spark-tested at 10,000 volts. Single-bed units are shipped knocked down, ready for simple and fast field erection and installation.

For lab, pilot plant . . .
MBD-6A mixed-bed demineralizer

This 6"-diameter unit contains a mixture of Permutit Q cation exchange resin and Permutit S anion exchange resin.

It will demineralize 1 to 2 gpm of water to a low total solids, low CO_2 and low silica content.

How they work, what they include

We shall be happy to send you full details on the operation of these units, the results you can expect, facts about their construction and installation. Ask for Bulletin No. 4721 or a consultation.

Glasteel pipe that you can field-cut

Here's a new, rugged, corrosion-resistant Glasteel pipe that you can cut to any length you want with a standard, dry abrasive cutoff wheel.

It's Pfaudler F-C (for "field-cut") pipe.* Once you cut the length you want, you thread, fire-polish and then finish with a belt-sander to provide a flat gasket seat.

Outside, the pipe is steel for strength; inside you have a ⅛-inch-thick glass lining that stands up to all acids (except HF) to 350° F. and to most mild alkalies at moderate temperatures. You can also use this pipe with abrasive fluids, sticky materials, and those you want to protect from contamination.

Pipe is rated at 150 psi and comes in 1½, 2 and 3-inch diameters, in lengths through 10 feet. Stock delivery.

Bulletin No. 989 provides complete specifications.

*Patent applied for

Ion Exchange . . . practical, profitable unit process

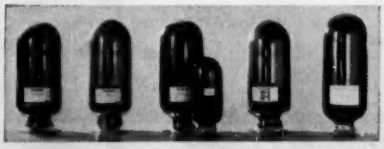
Ion exchange, the Permutit way, is a standard, unit operation for: purification, concentration, separation and addition. A versatile process, it involves many types of dilute solutions.

As the only manufacturers of both resins and equipment, Permutit is best able to control the ion exchange operation from beginning to end.

Rely on any or all of our services:

1. Technical assistance. Your problem and process will be thoroughly and expertly evaluated in terms of what ion exchange can do.

2. Wide choice of resins. From among Permutit's more than 30 ion exchangers, those best suited for your needs will be specified. In this wide selection you'll find many unique and specialized cation and anion exchangers, mixtures and miscellaneous adsorbents.



OVER 30 ION EXCHANGE RESINS are available from Permutit, along with the know-how and equipment that can help you get the most from this recognized unit operation. Samples on request.

3. Dollar-saving equipment. Frequently the equipment you need is already available as a "package" or can be quickly assembled from standard, stocked components. Naturally, custom units are also part of our service, and automatic equipment was pioneered by Permutit.

If you're interested in ion exchange, either (a) send for a 12-page booklet, "Permutit Ion Exchangers," or (b) send us an outline of your problem.

PFAUDLER PERMUTIT INC.

Specialists in FLUIDICS . . . the science of fluid processes

NEW FROM PERMUTIT!

Complete line— all-purpose Model BD Economy Softeners

Here's an answer to your need for more and more soft water at lower cost.

Taking advantage of new design advancements and standardized mass produced components, new Permutit Model BD Softeners now make Permutit quality available in a complete line, ready for prompt delivery from stock at economy prices.

BD Softeners contain only high-capacity Permutit Q Resin. Absence of subfill eliminates possibility of upsetting bed, makes installation simpler, less expensive. Exclusive double-dish underdrain is shipped completely assembled, further simplifies installation. Standard valve is the famous Permutit Multiport® type.

Available in flow rates of 40, 56, 77 and 100 gpm — with softening capacities of 510, 750, 1020, and 1380 kgr, respectively. Bulletin 4696 gives BD specifications and other details.

Handy FLUIDICS Buyer's Guide

gives you a complete look at the many products and services you can get through the Fluidics program. It shows you how to get answers to problems in such fields as water and waste treatment, corrosioneering, reaction, metering, fluid control, etc.

For your free copy, write to our Permutit Division, Dept. **CE-90,** 50 West 44th St., New York 36, N. Y.

*FLUIDICS is a new Pfaudler Permutit program that provides a modern, imaginative approach for handling and processing liquids and gases more profitably.

Stainless Steel heat exchangers duplicate outer space at -443°F.

Heat transfer units are used to simulate outer space conditions for static missile testing and high velocity gas research. The temperature drops to 443 degrees Fahrenheit below zero and the air pressure to only one-billionth of an atmosphere. Therefore, to obtain good service, *under these extreme conditions of near absolute zero temperature and pressure*, the "PLATECOIL" heat exchangers are made of Stainless Steel.

"PLATECOIL," a new development of Tranter Manufacturing, inc., Lansing, Michigan, was used as the heat transfer unit because it cools 50% faster, requires one-half the space and weighs one-half as much as coiled pipe. The units are made by embossing two sheets of metal with serpentine channels and welding them together to form double-sized channels. "From the first we have used Stainless Steel to make 'PLATECOIL,'" said Mr. C. P. Yoder, Manager of New Products Research and Development. "We made our first installation twelve years ago and the same equipment is still in use today! Our customer specified Stainless Steel to be sure his product would not be contaminated by corrosion.

"'PLATECOIL' is used to jacket the launching tubes on the Polaris submarine. Hot water is circulated through the 'PLATECOILS' to keep the rocket fuel at just the right temperature for quick launching. The units are made of Stainless Steel," reported Mr. Yoder, "to eliminate any possibility of corrosive scaling that might hamper the operation of the missile. No metal can match the strength and corrosion resistance of Stainless Steel. Our customers in the chemical, food processing and petroleum industries have found that Stainless Steel 'PLATECOIL' actually costs less because it lasts so long."

If you have an outer space or down-to-earth corrosion problem, you need the strength and durability of USS Stainless Steel. You can order it through your U. S. Steel representative or local Steel Service Center.

USS is a registered trademark

USS

United States Steel Corporation—Pittsburgh
American Steel & Wire—Cleveland
National Tube—Pittsburgh
Columbia-Geneva Steel—San Francisco
Tennessee Coal & Iron—Fairfield, Alabama
United States Steel Supply—Steel Service Centers
United States Steel Export Company
United States Steel

This mark tells you a product is made of modern, dependable Steel

How the bottleneck in packed tower Support Plates and Distributors

When towers were filled with the packings available a few years ago, a plate with a few holes was all that was needed to support the packing, and a few streams of liquid all that was needed to wet it.

Low in efficiency, low in capacity, low in flooding limits, the packing itself was the bottleneck to effective mass transfer.

But the bottleneck shifted from packings to support plates and distributors when high-efficiency, high-capacity packings, such as Intalox Saddles and Pall Rings, were developed. Higher flooding limits of the new packings were meaningless with the low flooding limits of the available support plates. Higher gas handling capacities of the new packings were stymied by the poor gas handling capacity of the support plate. The greater surface area and better internal distribution characteristics of the new packings could not be used to their maximum value because of poor initial distribution from the distributor plates available.

Our engineers went to work. Scale models of design after design were given preliminary tests in a four inch tower. Those that showed promise were made in a 30″ size and subjected to test run after test run in our large experimental towers. Field experience in towers up to 10′ in diameter was then evaluated against our test findings.

The "gas-injection" principle in support plates was one result of this intensive program. The "weir-flow" principle in distributor plates was another.

Today, U. S. Stoneware produces a wide range of support plates and distributors based on these principles which permit the engineer to utilize to the full the high performance characteristics of Intalox Saddles and Pall Rings in effecting mass transfer.

A few of these *are* illustrated and described briefly on these two pages. Full technical data is given in Engineering Manual TA-40 sent free on request.

FOR HIGHEST EFFICIENCY, HIGHEST CAPACITY COUPLE "U. S." TOWER PACKING WITH "U. S." TOWER ACCESSORIES

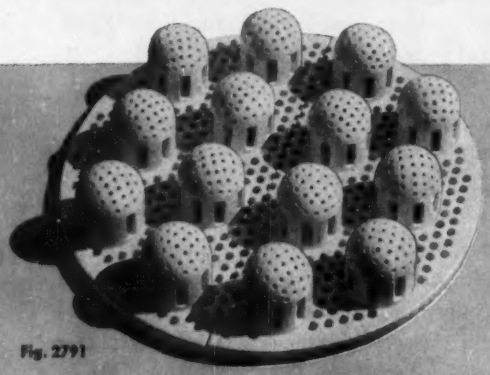


Fig. 2791

CERAMIC "GAS-INJECTION" SUPPORT PLATE
Slotted risers with perforated caps inject the gas into the tower. Liquid leaves the column through holes in the base plate. All plates through a size range from 12" through 60" have an effective working free area of better than 50%.

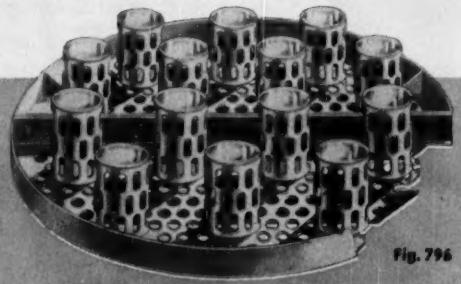


Fig. 796

METAL "GAS-INJECTION" SUPPORT PLATE
Similar in design to Fig. 2791; for towers from 4" dia. through 48"; percentage of free area generally exceeds 75%. Available in carbon steel, stainless steels, aluminum, copper, nickel, or any of the weldable alloys.

"WEIR-FLOW" CERAMIC DISTRIBUTOR
Cylindrical risers with "V" notches serve as downcomers for liquid, permitting greater flow as the head rises. The plate is supported on lugs which permit an annular space between distributor and tower wall through which gas rises. Ceramic "weir-flow" distributors are available for towers from 24" dia. through 96".

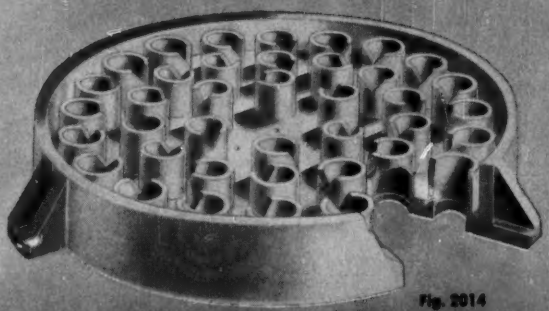


Fig. 2014

performance shifted to AND WHAT WE HAVE DONE ABOUT IT!

"MULTI-BEAM" METAL SUPPORT PLATE
With a free area generally exceeding 85%, this "gas-injection" design principle is available in separate metal beams to fit towers up to ten feet or more in diameter. Number of sections vary from three to ten.

SPECIAL SUPPORT PLATES
Special support plates incorporating the "gas-injection" principle are available fabricated from impervious graphite, fiberglass reinforced polyester resin, or titanium.

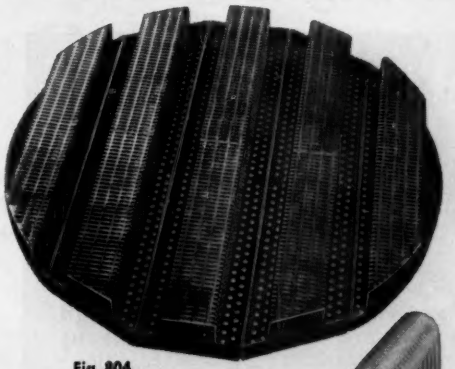


Fig. 804

METAL "WEIR-FLOW" DISTRIBUTORS
The basic "weir-flow" principle is shown here incorporated into a sectionalized metal distributor. Plates of this type can be made to fit towers of unlimited size. Metal "weir-flow" distributors are also available in one- or two-piece construction for towers up to 48" in diameter.

Fig. 798

"MULTI-BEAM" CERAMIC SUPPORT PLATE

Fig. 2808

For towers of 24" diameter up through 108". Made in the form of multiple beams for installation through manways. Has twice the load bearing capacity of Fig. 2791, even greater free area, yet retains all the advantages of the "gas-injection" principle.

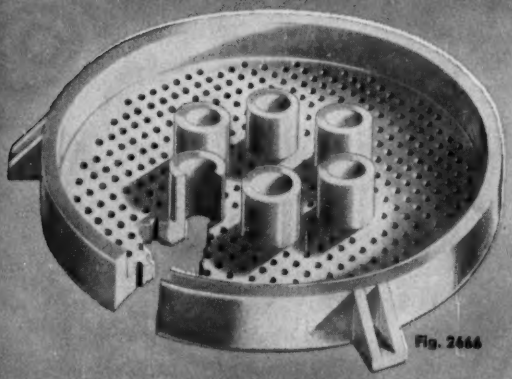
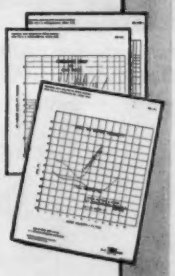


Fig. 2666

CERAMIC "ORIFICE" DISTRIBUTOR
This new distributor, on which patents are pending, is unique in that it offers the user a choice of three liquid rate ranges, enabling him to match his distributor to his flow requirements. For example, in a size to fit a 48" tower, Fig. 2666 is available for a liquid rate ranging from 12 to 50 gpm., or from 50 to 113 gpm., or from 113 to 414 gpm. This new distributor is made in chemical porcelain or in heat-shock resistant chemical stoneware in sizes to fit towers from 10" in dia. through 80".

ARE YOU RECEIVING THESE REPORTS FROM OUR CONTINUING RESEARCH INTO PACKED TOWER PERFORMANCE?



In our engineering laboratories, in a series of absorption and distillation towers up to 30" in diameter, we are continually evaluating the performance of tower packing and tower accessories under a wide range of operating conditions. If you would like copies of these studies please write us on your letterhead. Ask, too, for a copy of Engineering Manual TA-40.

Process Equipment Division

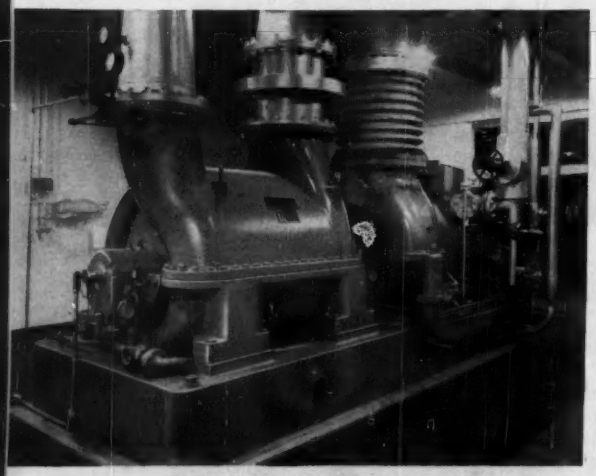
U. S. STONEWARE
AKRON 9, OHIO

258-G

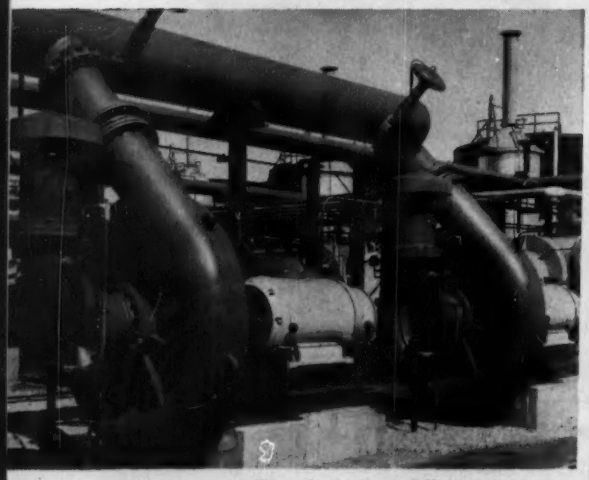
New York • Chicago • Houston • Los Angeles

in Chemical and Petroleum Refining Service–

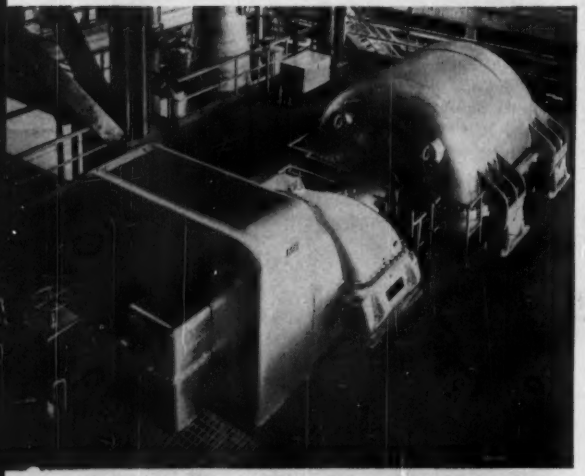
ELLIOTT



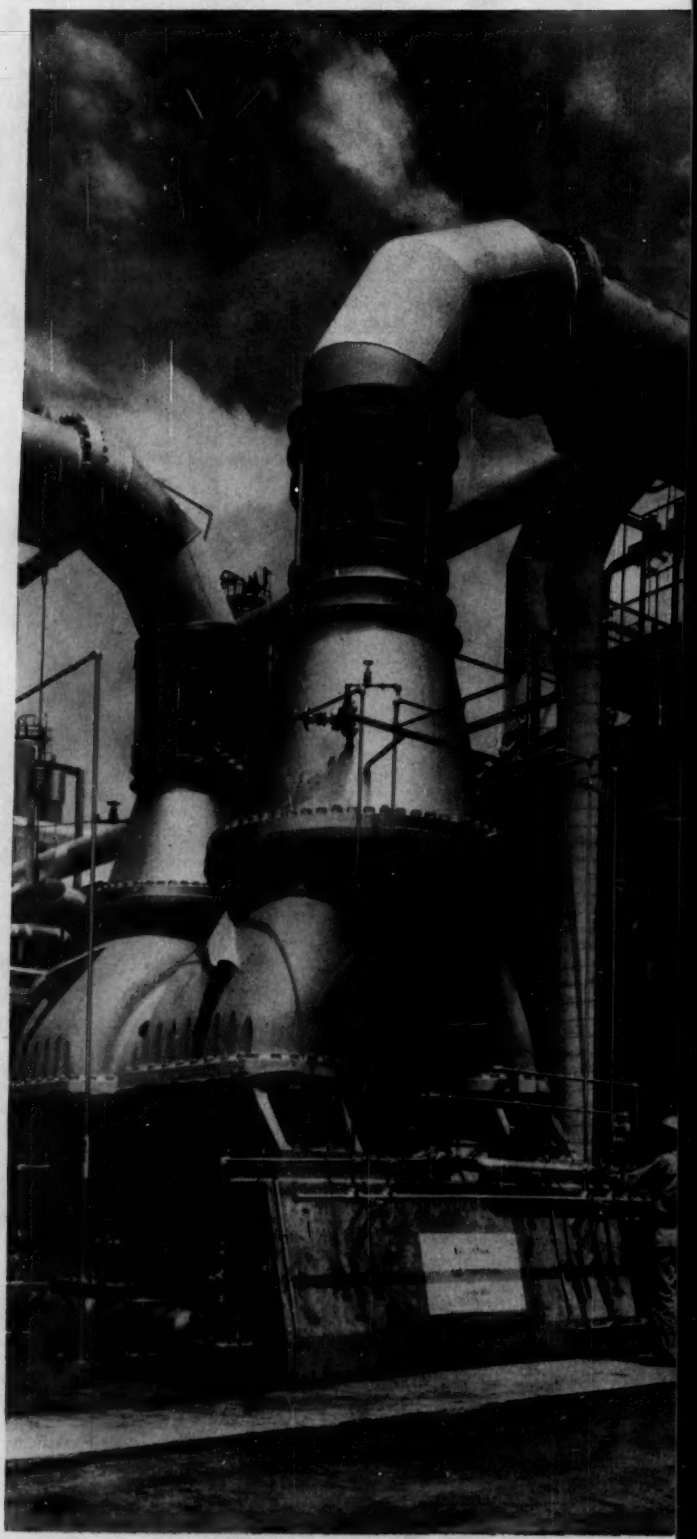
Elliott multi-stage compressor with 2035-hp Elliott turbine drive, in refinery service.



Two single-stage Elliott compressors driven by Elliott motors.



One of the largest turbine-driven multi-stage compressors ever installed, for fluid catalytic cracking unit.



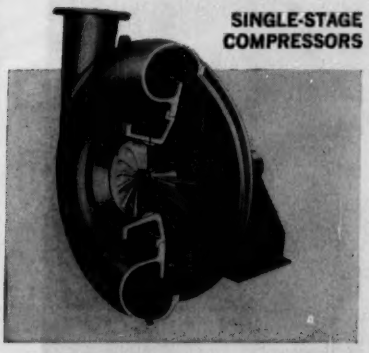
One of the large axials serving a Petro-Chemical plant.

COMPRESSORS

Today's most complete line of centrifugal and axial machines from **500** *cfm to* **600,000** *cfm*

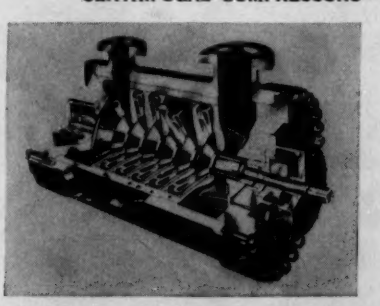
48 FRAME SIZES WITH MATCHING DRIVERS
With this, the most-complete line of centrifugal and axial compressors available today—Elliott offers an unexcelled range of choice of established machines. In addition, there is the extra advantage of matching Elliott turbine or motor drivers. Both units engineered and built by Elliott is a decided "plus" because it means unified responsibility, unified service.

SINGLE-STAGE COMPRESSORS



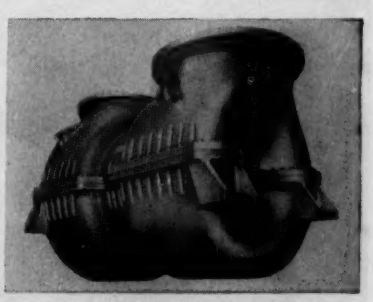
Elliott single-stage centrifugal compressors range in size from 700 to 100,000 icfm and above. They are readily adaptable to special service conditions, and to the handling of corrosive or dirty gases. A variety of impeller designs, bearings, seals, and materials of construction permits each unit to be tailored to its particular application.

MULTI-STAGE CENTRIFUGAL COMPRESSORS



Elliott multi-stage compressors are made in a wide variety of sizes and styles, to serve many difficult and exacting applications. They are available with inlet capacities up to approximately 150,000 icfm. Impellers, casings, internal passages and bearings for each type of machine have been designed to provide smoothly operating, rugged, dependable machines.

AXIAL FLOW COMPRESSORS



Multi-stage compressors of the axial flow type are designed and engineered specifically to serve the needs of industry for the handling of air or gas mixtures in large volume flow operation. Applications include petroleum refining, chemical processing and the steel industry. Frame sizes are rated up to approximately 600,000 cubic feet per minute when operating on air.

MATCHED MOTOR OR TURBINE DRIVE
Elliott is a leading manufacturer of both steam turbines and electric motors, of all types and ratings necessary to provide driving power for the compressor units described above. Consequently, we are in position to recommend and furnish the type of drive best suited for each application.

FOR AIR OR GASES
Elliott integrated compressor units are available for handling all types of compressible fluids, within the pressure and flow limits of the machines. Where corrosive gases are handled, special materials are employed in vulnerable spots; where high pressures are needed, extra heavy construction is used; where leakage must be prevented, special shaft seals are available; where high temperatures must be avoided, provision is made for cooling.

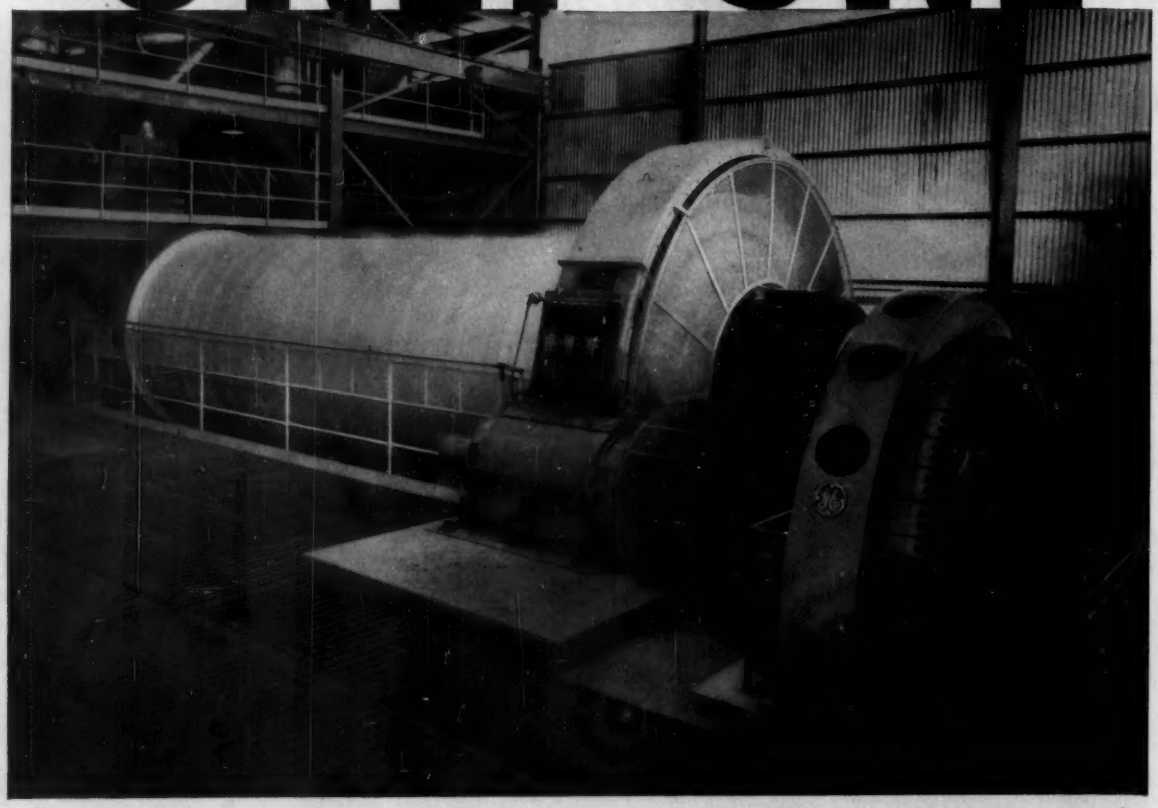
48 STANDARD FRAME SIZES
The total of 48 frame sizes permits accurate application for all compressor problems over the entire range of 500 cfm to 600,000 cfm. Pressures and speeds can be selected to meet the characteristics of the application, and the gas to be handled. *For further information, write Compressor Department, Jeannette, Penna.*

ELLIOTT THE MOST COMPLETE LINE OF
INTEGRATED COMPRESSOR & DRIVER UNITS 500 cfm to 600,000 cfm

ELLIOTT Company
Jeannette, Penna.

PO-1

ONLY ONE

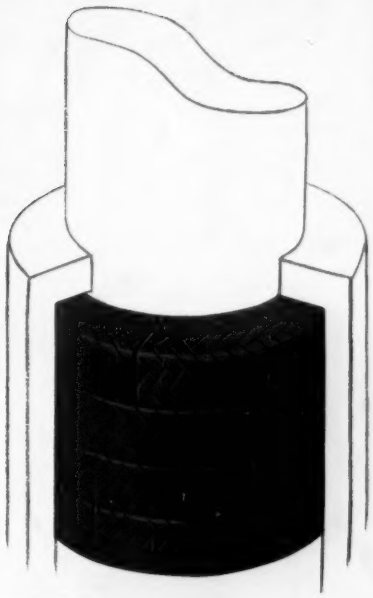


ONLY ONE TYPE AND SIZE FINISHING MILL WILL DO THE BEST JOB IN YOUR PLANT. THAT'S THE MILL TRAYLOR WILL BUILD FOR YOU

From requirements outlined by Standard Lime and Cement Company, Traylor engineers built this 10′ x 32′ two compartment ball mill for installation at Martinsburg, West Virginia. Write today and tell us the size product and capacity needed for a grinding mill in your plant. Our engineers, expert in this field, will recommend the mill Traylor-made specifically to fill your requirements most efficiently . . . most economically.

TRAYLOR ENGINEERING & MANUFACTURING
DIVISION OF FULLER COMPANY
1551 MILL ST., ALLENTOWN, PA.

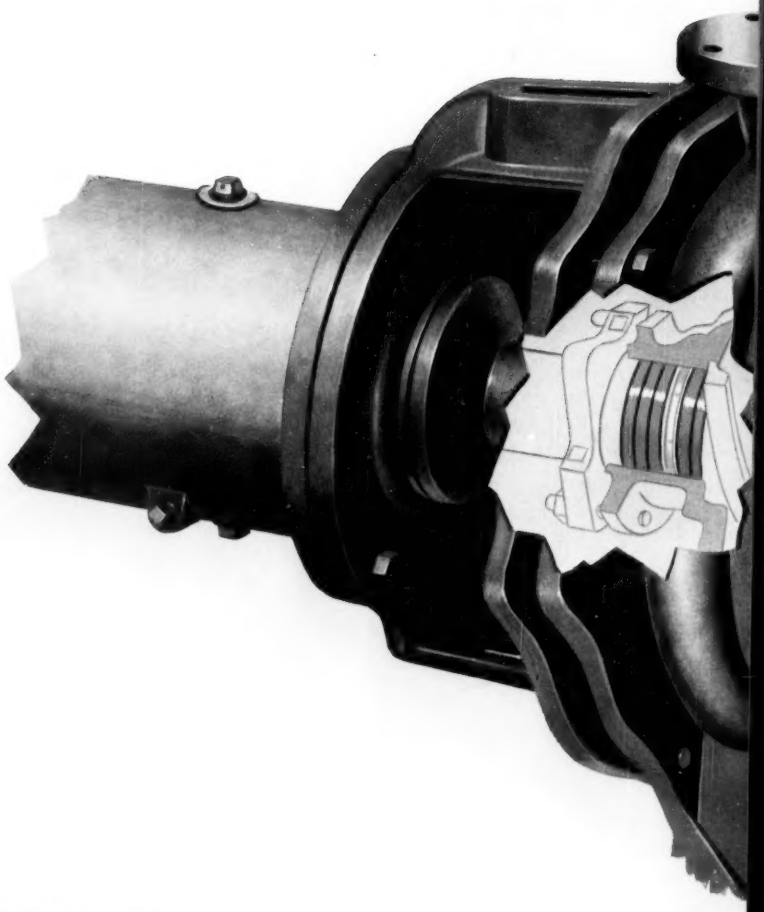
NEW COST-CUTTING BRAIDED FIBER PACKINGS OF DU PONT "TEFLON" TFE FIBER



*Teflon is Du Pont's registered trademark for its TFE-fluorocarbon fiber

Save up to 50% of your total valve

BRAIDED PACKINGS O



CUT YOUR OPERATING COSTS, TOO

These installations did . . .

SAVES $70.60/YR. IN LABOUR PUMP. Exposed to 101% fuming nitric acid at 1,750 rpm, braided packing of "Teflon" TFE fiber operated satisfactorily for 7 months. Blue cape asbestos had to be replaced every few weeks.

SAVES $123.80/YR. IN CENTRIFUGAL PUMP. Braided packing of "Teflon" TFE fiber resisted 45% sulfuric acid at 77°F. for 46 days. Blue cape asbestos impregnated with TFE resin lasted only 7-10 days.

SAVES $79.00/YR. IN TABOR DEEP-WELL PUMP. Braided packing of "Teflon" TFE fiber stood up to chlorosulfonic acid at 45 psi for 3 months. Blue asbestos impregnated with petrolatum and graphite averaged 1 month's service.

and pump-packing costs with

DU PONT "TEFLON" TFE FIBER

It's completely new . . . "Teflon" TFE fluorocarbon fiber with distinctly improved physical properties as compared to the resin form of "Teflon". When braided, this fiber makes a packing material that offers the economy of extra-long service in valves and pumps handling **any** liquid.

In specific applications, braided packings of new "Teflon" TFE fiber outlasted other packing materials up to 8 times over in handling corrosive liquids...kept equipment on the job longer, cut down time, labor repacking schedules. Savings in total packing costs: 50%.

Here are the advantages of new "Teflon" TFE fiber that make such economies possible:

Higher compressive strength "Teflon" TFE fiber has a compressive strength of 60,000 psi vs. 2,500 psi for the plastic form of "Teflon". Result: Fiber resists cold flow much better. Low porosity of this new fiber means easier, tighter seals, too.

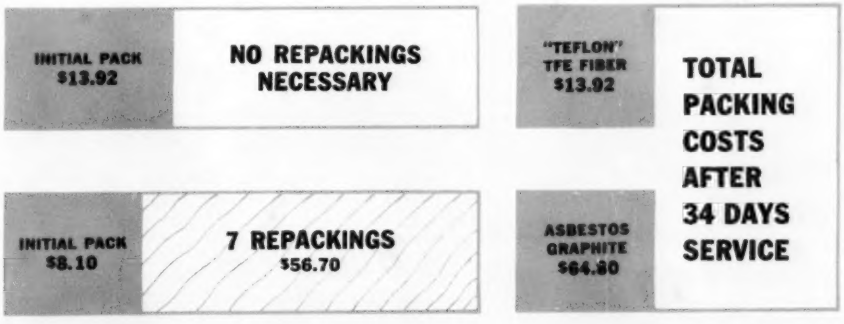
Higher tensile strength "Teflon" TFE fiber is roughly 20 times stronger than the plastic form of "Teflon" (50,000 psi vs. 2,500 psi). Result: Fewer adjustments needed, quicker run-in time.

Low coefficent of friction "Teflon" has the lowest coefficient of friction of any known solid (0.02). New braided packings have less tendency to score shafts, practically eliminate seizure. Often **no** lubrication is needed!

High chemical resistance, heat stability "Teflon" TFE fiber is chemically inert. No solvent has been found for it—even boiling aqua regia has no effect. It can be kept in continuous service over a temperature range of –100°F. to 500°F. Result: Use stronger processing chemicals at higher temperatures to speed production.

SAVES $305.70/YR. IN CENTRIFUGAL PUMP—pays for itself in 8 days. Braided packing of "Teflon" TFE fiber gave 34 days' service in a centrifugal pump handling molten urea at 266°F. before repacking was needed. An asbestos/graphite packing required 7 packings over the same period (see chart).

Though initial cost was higher, the braided packing of "Teflon" TFE fiber paid for itself in 8 days!



IT WILL PAY YOU

TO INVESTIGATE BRAIDED PACKINGS OF NEW "TEFLON" TFE FIBER

If your pumps and valves handle liquids of any type – from water to corrosive acids or "problem" solvents – there's a good chance braided packings of new "Teflon" TFE fiber can cut your over-all repacking costs. They might help you to improve your processes by using stronger chemicals, too . . . increase your production rates.

Two types available. Braided packings of new "Teflon" TFE fiber have a distinctive brown color and are available in two basic types: braided packings of 100% "Teflon" TFE fiber and braided packings of 100% "Teflon" TFE fiber impregnated with "Teflon" TFE suspensoid. Both types are furnished in coil and ring forms in sizes from ⅛" to 1½".

IMPORTANT: At temperatures over 400° F. hazardous vapors are given off by "Teflon". These vapors are toxic and should not be breathed. Adequate ventilation and care to avoid breathing the vapors from hot "Teflon" should provide ample safety.

Care should be exercised not to contaminate smoking tobaccos with "Teflon". Such a mixture would be particularly bad, as the products of combustion of "Teflon" could be directly inhaled. Because the color of "Teflon" makes it hard to distinguish if mixed with tobacco, is recommended that cigarettes or tobacco n be carried into areas where they might becor contaminated.

When not at elevated temperatures, "T lon" is unusually inert. Animal feeding tes clearly indicate "Teflon" causes no significa detrimental effect when taken internally reasonable quantities. Other animal tests in cate "Teflon" produces no skin irritation. D tailed information will be provided upon reque

For more information and free sample, clip and mail coupon or write: E. I. du Pont de Nemours & Co. (Inc.), Textile Fibers Department, 31 E Centre Road Bldg., Wilmington 98, Delaware.

Note: Du Pont makes "Teflon" TFE fiber, but does not produce braided packings.

E. I. du Pont de Nemours & Co. (Inc.)
Textile Fibers Dept., 31 E Centre Road Bldg.
Wilmington 98, Delaware

Please send me my free sample of braided fiber packing of "Teflon" and more technical information. I am interested in using this new packing material for .....

Name.....Position.....

Firm.....

Address.....

City.....State.....

DU PONT "TEFLON" TFE FIBER

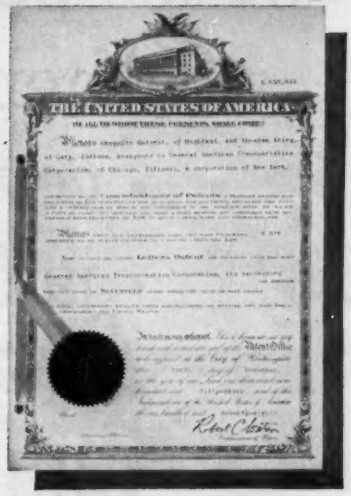
DU PONT

REG. U. S. PAT. OFF.

BETTER THINGS FOR BETTER LIVING . . . *THROUGH CHEMISTRY*

a Reminder

to those who use chemical nickel alloy plating:



There is only ONE

Kanigen®

and 29 patents prove it

There are no substitutes for Kanigen—no other process that applies a hard, corrosion-resistant nickel alloy coating without the use of electricity as Kanigen does.

With Kanigen, you can plate anything from a small relief valve to a 20,000 gallon tank car with a virtually non-porous, uniform coating.

How can you be sure of getting Kanigen? Only one way—by calling General American or one of its licensees. For further information write:

Kanigen Division

GENERAL AMERICAN TRANSPORTATION CORPORATION

135 South LaSalle Street
Chicago 3, Illinois
Offices in principal cities

KANIGEN GENERAL AMERICAN

LICENSEES

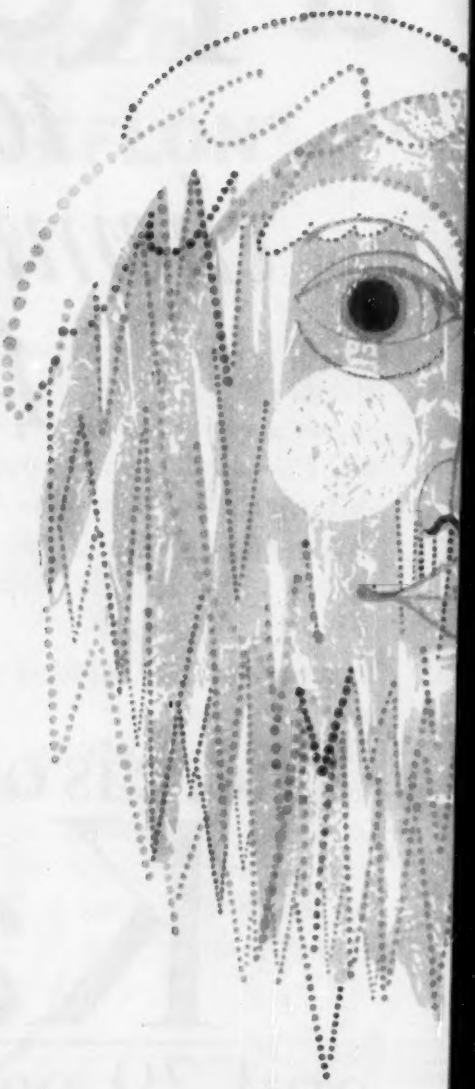
INDUSTRIAL KANIGEN CORPORATION
1421 Park Avenue
Emeryville, California

KEYSTONE CHROMIUM CORPORATION
1095 Niagara Street
Buffalo, New York

KEYSTONE METAL FINISHERS, INC.
22 Raydol Avenue
Secaucus, New Jersey

You can meet any combination of temperature and weather with J-M

- cements
- jackets
- coatings
- fills



Along with the widest assortment of industrial insulations available, Johns-Manville offers a full line of cements, jacketing materials, coatings and fills. These important accessory items have been specially developed for use with J-M insulations to withstand both high process temperatures *and* exposures to all kinds of weather extremes on the job.

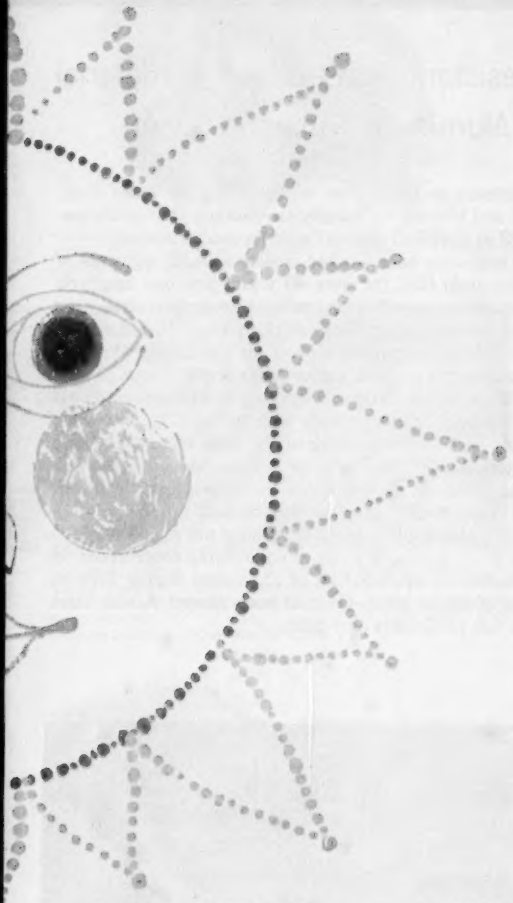
Don't settle for half a specification. Let your insulation contractor furnish the right combination of Johns-Manville materials vital to the satisfactory completion of any insulation job.

More than a century's experience in development and manufacture of top quality insulating materials insures the ability of Johns-Manville to meet *any* requirements and all extremes of temperature and weather. Talk over your specific needs with your J-M representative, or write Johns-Manville, Box 14, New York 16, N. Y. In Canada: Port Credit, Ontario.

JOHNS-MANVILLE

JOHNS MANVILLE JM PRODUCTS

AN INSULATION FOR EVERY COMMERCIAL AND INDUSTRIAL USE



See how J-M offers materials to match your specific needs

J-M CEMENTS are designed for insulating or finishing applications. Eight types are made for general and special purpose use from such base materials as asbestos, magnesium carbonate, diatomaceous silica, mineral fiber, expanded vermiculite, hydraulic-setting cement, etc. Temperature limits range as high as 1900F.

J-M WEATHERPROOFING JACKETS for fire resistance and weatherproofing can be furnished factory-applied to pipe insulations, or separately for on-the-job installation, in a wide range of thicknesses and weights. Twelve different jackets to choose from—for temperatures to 250F.

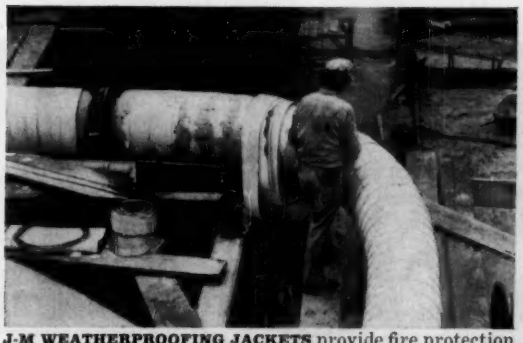
J-M INSULKOTE® weather-protective coatings guard insulation against corrosive atmospheres and extremes of weather. Insulkote can be troweled or gunned in place on vessels, tanks, piping and equipment. Available in six types, both "breathing" and "non-breathing."

J-M FILLS are recommended for insulating irregular spaces in high-temperature equipment.

Ask your J-M Insulation Contract Unit about these and the other quality insulating materials by Johns-Manville—your best assurances of long, trouble-free performance on the job.

JOHNS-MANVILLE INSULATING and finishing cements are applied over flat or irregular surfaces to give a smooth, crack-free finish that can easily be painted or given an additional weather-protective coating.

J-M INSULATING CEMENT can be applied by troweling in place . . . here, on a large cylindrical vessel previously covered with blanket insulation.



J-M WEATHERPROOFING JACKETS provide fire protection and weatherproofing as they meet any hot or cold insulating requirement. Most of the 12 available types are made of asbestos, felt-coated and saturated with asphalt.

J-M INSULKOTES can be ready-mixed and applied by trowel or spray gun over wire or Duramesh® fiber glass reinforcements. They effectively seal out moisture to prevent equipment corrosion . . . safeguard insulation investment.

See why ALCOA ALUMINUM makes a good design habit

Requirement: Low-cost, corrosion-resistant heat exchanger material

Key to Good Design: Specify Alcoa Aluminum Tube and Sheet

If corrosion resistance, long life, product purity and economy are considerations in your heat exchanger application, specify aluminum! ALCOA® Aluminum has been solving such problems for over 40 years.

In the petroleum industry, ALCOA Aluminum Tubes serve in main column overhead condensers where their freedom from fouling and excellent heat transfer properties have made them a natural selection. Heat exchangers made of ALCOA Aluminum Tube and Plate are used in the production of ammonia, nitric acid, vegetable oils, naval stores, naphthalene, hydrogen peroxide, oxygen and urea. These and other processes call for heat exchangers with combinations of high strength, excellent sub-zero physical qualities, high thermal conductivity, or nontoxic and noncatalytic properties. ALCOA Aluminum alloys meet all these requirements.

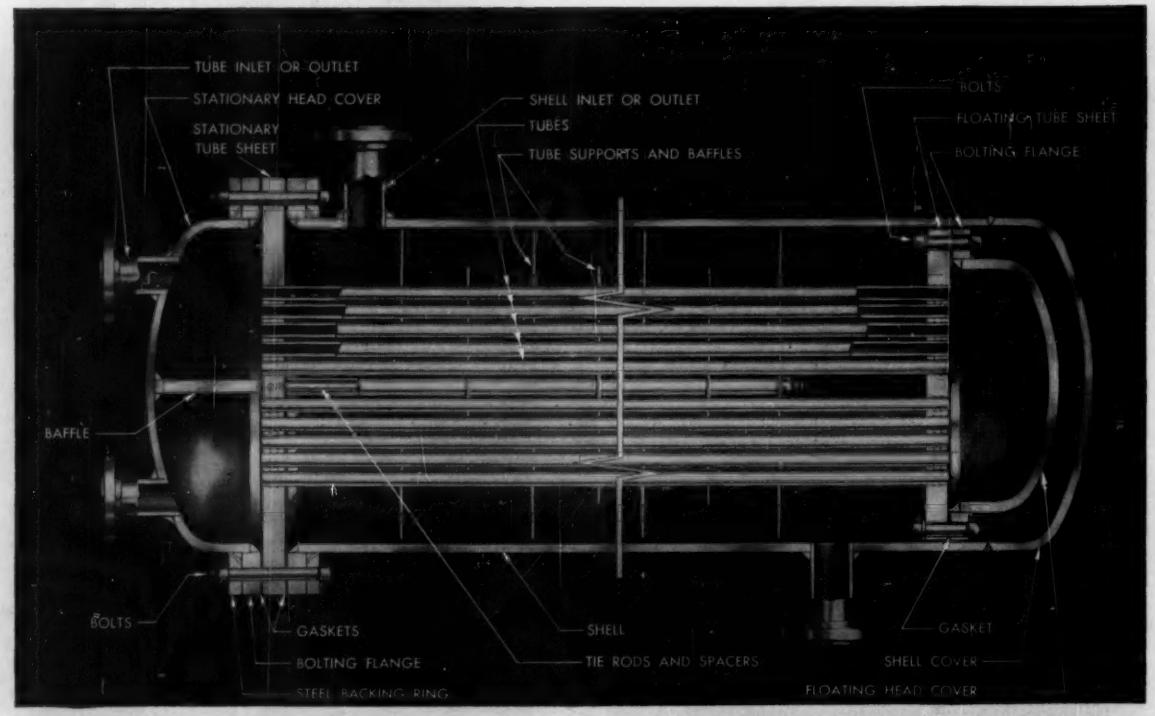
As for cost, ALCOA Aluminum Tube is the most inexpensive. In the common sizes it costs one-third less than mild steel, one-half as much as admiralty, and one-fifth that of stainless.

ALCOA Aluminum alloys are ideally suited to a wide range of maintenance methods. For relatively soft or loose scale, water jets and brushes are usually satisfactory. Wet sandblasting as well as chemical cleaners may be used effectively.

ALCOA engineers have worked closely with all segments of the process industries for over 40 years, and can help you specify the aluminum alloy best suited to your heat exchanger and other process applications. ALCOA's unparalleled experience in this field is available to you for the asking. Write to the address on the coupon, stating your requirements as specifically as possible. ALCOA's development engineers will welcome the opportunity to work with you on your problems.

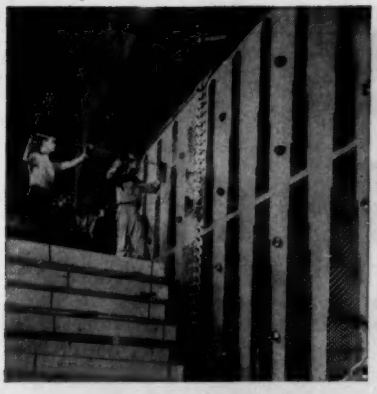
You can also take advantage of the wide selection of free ALCOA literature on aluminum for heat exchangers and other process applications. Simply check the booklets you want on the coupon and mail to the address indicated. ALCOA will forward your material promptly and without obligation.

ALCOA is conducting a series of engineering conferences on process industries applications of aluminum during 1960 in a number of major cities. Contact your nearest ALCOA sales office for full particulars and dates.



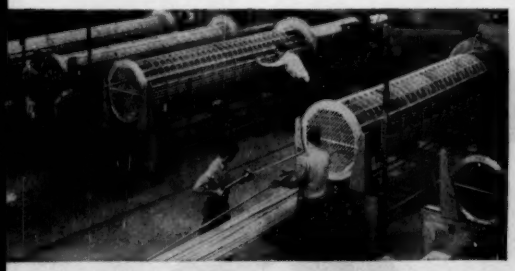
For certain processes where corrosive or sensitive materials are involved, it is often advisable to use aluminum for entire heat exchanger systems to avoid system corrosion and contamination of the product. A typical all-aluminum heat exchanger is shown here. Alloy recommendations are given in the table opposite.

Alcoa Aluminum Tubing protects color in the world's largest rotary steam-tube drier. The drier measures 10 ft in diameter by 100 ft long.

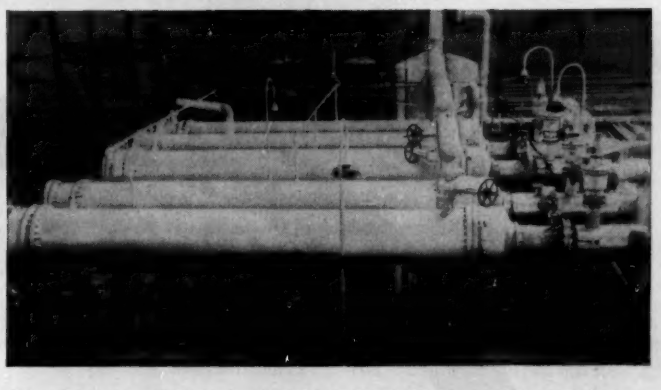


A Midwest utility saved 50 per cent on tubing costs by using Alcoa Aluminum instead of admiralty for tubing in this surface condenser. Successful operation of this unit has led to the installation of similar units by other utilities. This use demonstrates aluminum's economy and superior resistance to ammonia, carbon dioxide and hydrogen sulfide.

A battery of all-aluminum heat exchangers in a polyethylene plant. Selected for initial low cost, these aluminum exchangers provide freedom from product contamination as well as desirable low temperature properties.



Construction of a heat exchanger utilizing Alcoa Aluminum Tube. Superior working properties plus the cold-drawing method by which Alcoa seamless heat exchanger tubes are produced results in close dimensional tolerances and smooth inside and outside surfaces.



This all-aluminum dephlegmator in a large coke plant is used for the regeneration of ammonia liquor in a hydrogen sulfide scrubbing operation. Aluminum tubes lasted five times longer than steel tubes in a similar use.

Alloy Recommendations for Aluminum Heat Exchanger Construction

	Alcoa Designation	ASTM Specification*	Alloy
Tubes	3003-H14	B234	M1A
	Alclad (inside) 3003-H14	B234	clad M1A
	Alclad (outside) 3003-H14		clad M1A
	Alclad (both sides) 3003-H14		clad M1A
	6061-T6	B234	GS11A
	6062-T6	B234	GS11C
Tube Sheets	3004-H112	B178	MG11A
	Alclad 3004-H112	B178	clad MG11A
	6061-T6	B178	GS11A
	Alclad 6061-T6	B178	clad GS11A
Baffles	3003-H14	B178	M1A
	Alclad 3003-H14	B178	clad M1A
Tie Rods	6061-T6	B273	GS11A
Shells & Headers	3003-H112	B178	M1A
	Alclad 3003-H112	B178	clad M1A
	3004-H112	B178	MG11A
	5052-H112	B178	GR20A
	5154-H112	B178	GR40A
Fittings	3003-F	B274	M1A as applicable
	6061-T6	B274	GS11A as applicable
Flanges	6061-T6	B247	GS11A as applicable

*Only the basic number is shown since Alcoa products are manufactured to the latest issue of the specification. The complete number would indicate the year of issue.

Aluminum Company of America, 871-J Alcoa Building, Pittsburgh 19, Pa.
Please send me the following literature covering Alcoa Aluminum for product transfer and other uses in the process industries:

- ☐ 10197 Aluminum Pipe and Fittings
- ☐ 10418 Alcoa Unitrace: Combines Piping and Tracing in One Unit
- ☐ 10270 Alcoa Utilitube
- ☐ 20849 Resistance of Aluminum Alloys to Weathering and Resistance of Aluminum Alloys to Chemically Contaminated Atmospheres
- ☐ 10460 Process Industries Applications of Alcoa Aluminum
- ☐ 11453 Solving Refinery Corrosion Problems with Aluminum
- ☐ 20437 Aluminum Alloy Heat Exchangers in the Process Industries
- ☐ 19416 Brazing Alcoa Aluminum
- ☐ 10415 Welding Alcoa Aluminum
- ☐ 19051 Alcoa Aluminum Handbook

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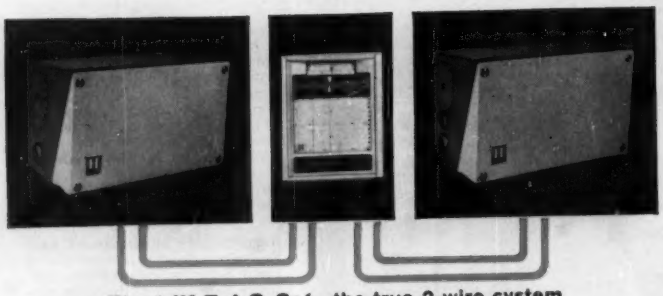
ALCOA ALUMINUM
ALUMINUM COMPANY OF AMERICA

For exciting drama watch "ALCOA THEATRE" alternate Mondays NBC-TV, and "ALCOA PRESENTS" every Tuesday, ABC-TV



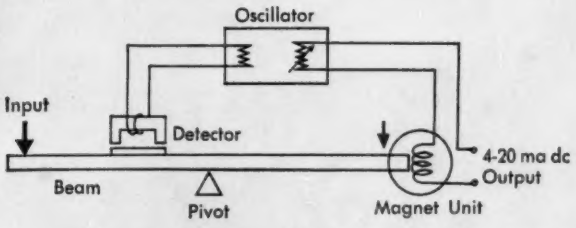
***ElectriK Tel-O-Set*—the true 2-wire system**

Care and feedback of delicate inputs

Delicate inputs thrive on the tender care of *ElectriK Tel-O-Set's force-balance feedback system*. This system, used as the basic circuit in *Tel-O-Set* transmitters, receivers, controllers, and other instruments, has proved itself in thousands of installations in the last five years. The force-balance feedback circuit increases the accuracy and dynamic response of the system by decreasing hysteresis effects and sensitivity to changes in ambient conditions.

Observe: (1) input force (from bellows, Bourdon tube, or displacement linkage) deflects pivoted beam; (2) air-gap in ferrite detector increases, (3) producing a change in inductance in oscillator circuit; (4) a portion of output current is fed back into magnet unit, producing a force on beam which is equal and opposite to input force; feedback balances beam. Full scale motion is only one-thousandth of an inch.

The advanced control engineering seen in force-balance feedback is carried through the entire *ElectriK Tel-O-Set* System. Specifically, there's no external power required at any field-mounted *Tel-O-Set* instrument. Line power connection is made only at the receiver. Two-wire d-c transmission eliminates shielding problems. The 4-20 milliamp signal range of the system gives a live zero and permits the use of the most reliable transistors available. The d-c signals



can be fed into data handling systems and millivolt-actuated instruments . . . can be easily transduced to a standard 3-15 psi pneumatic signal to operate existing pneumatic systems.

Take a new look at your control applications with the *ElectriK Tel-O-Set* System in mind! Get complete technical data from your local Honeywell field engineer. Call him today . . . he's as near as your phone. MINNEAPOLIS-HONEYWELL, 21 Penn Street, Fall River, Massachusetts.

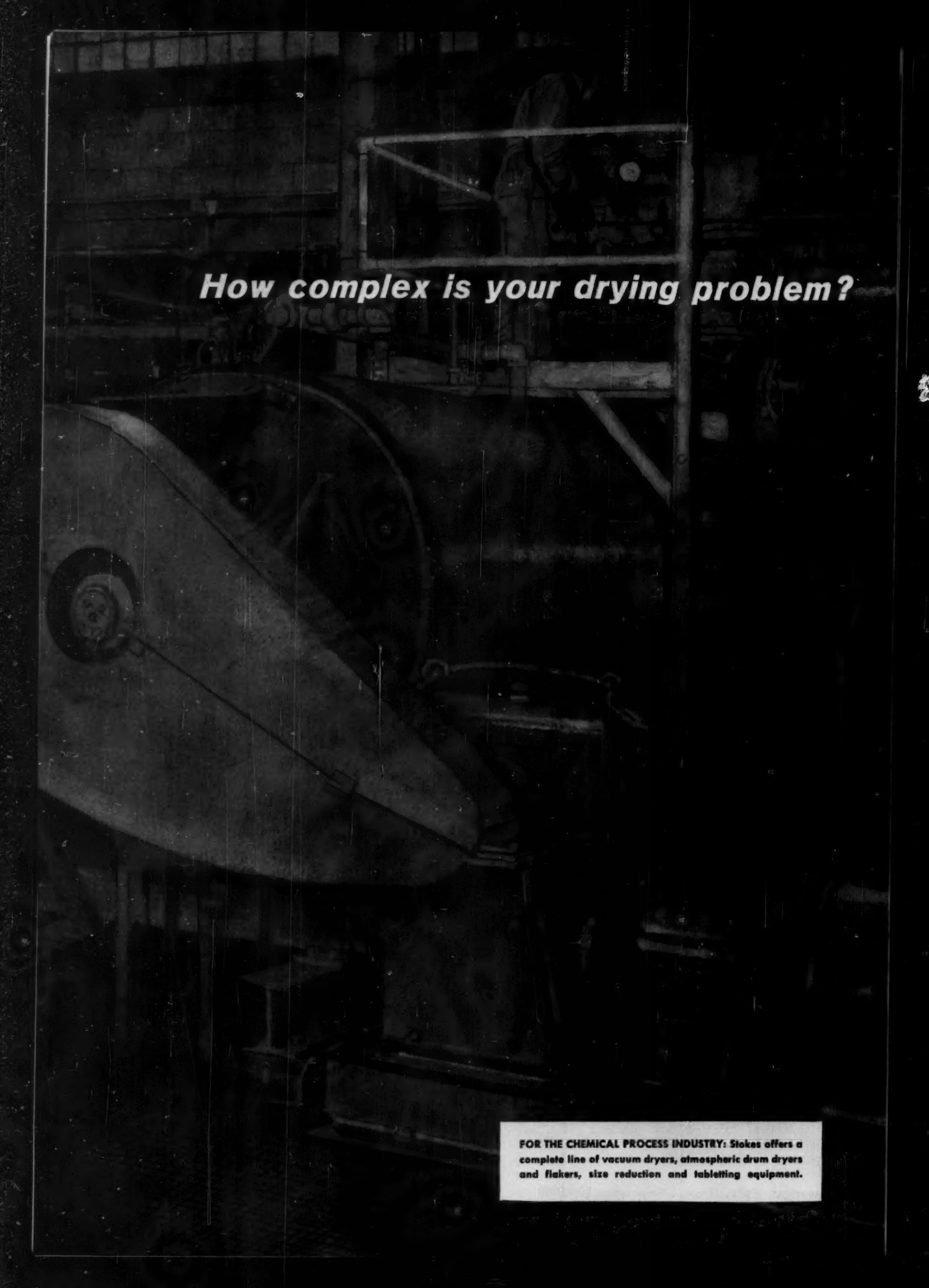
Honeywell

First in Control

SINCE 1885

75th YEAR

ENGINEERING THE FUTURE


How complex is your drying problem?
FOR THE CHEMICAL PROCESS INDUSTRY: Stokes offers a complete line of vacuum dryers, atmospheric drum dryers and flakers, size reduction and tabletting equipment.

LET STOKES UNIQUE VACUUM DRYING EXPERIENCE and EQUIPMENT WORK for YOU

Processing tonnage quantities of materials in an inadequate vacuum dryer can be time consuming and costly. That's why Stokes experienced vacuum engineers study each drying requirement individually . . . then design the drying system to meet your specific needs. Drying systems from —60°F to 400°F, and in capacities from a few pounds to several tons are available . . . along with application engineering, laboratory service and pilot plant operations. Stokes puts its 50 years of vacuum and processing experience to work on every drying problem . . . bringing you both money-saving and quality results. What's more, Stokes manufactures all its own pumps and accessories to assure you one-manufacturer responsibility in addition to unparalleled vacuum know-how.

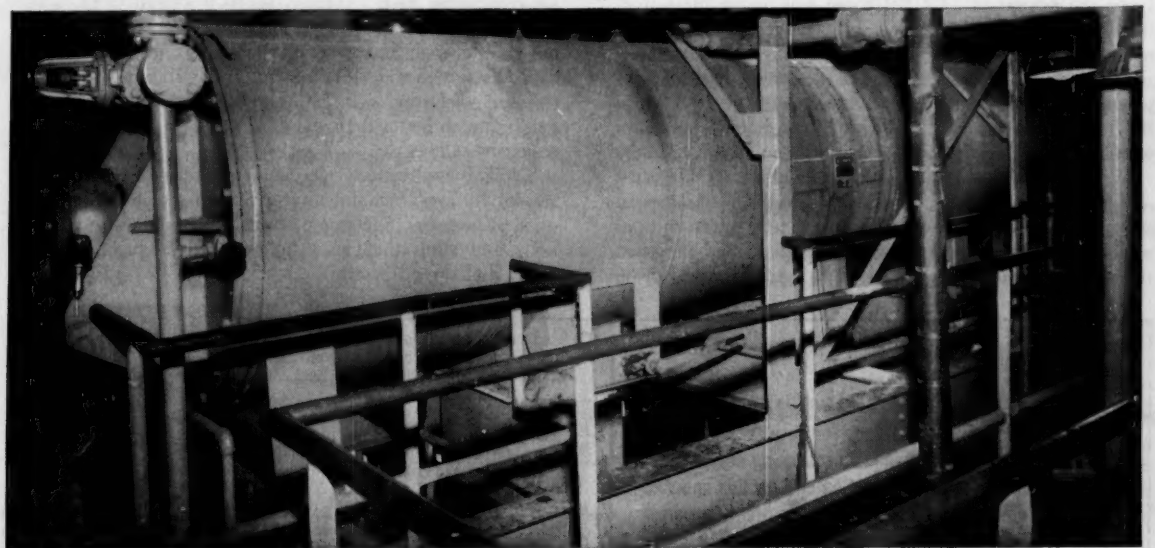
Stokes will work closely with your engineers to thoroughly explore the production problems . . . make recommendations on the basis of a practical knowledge of process operations . . . and confirm the recommended equipment by actual pilot plant production in the Stokes laboratory, if necessary.

Our representative in your area will initiate Stokes action to assure the best answer to your drying problem. Why not call him soon. Or if you prefer, write for new summary booklet on drying applications.

STOKES

Chemical Process Equipment Division

F. J. STOKES CORPORATION • 5500 Tabor Road • Philadelphia 20, Pennsylvania



Pictured above is one of two Stokes rotary vacuum dryers used to process Xanthates in the Welland plant of North American Cyanamid, Ltd. Continuous operation that means no maintenance shutdowns, process uniformity that means more pounds of salable product, and operating efficiencies that mean more profit are standard features of these Stokes rotary vacuum dryers.

WHY ARMCO 17-4 PH STAINLESS STEEL IN PRODUCTION AND PERFORMANCE OF

High Strength Plus Corrosion Resistance

Until the advent of 17-4 PH there was no stainless steel that combined exceptionally high strength with excellent corrosion resistance. For pump shafts, high pressure bolting and many other applications, designers had to compromise with the relatively low strength of the 18-8 types, the limited corrosion resistance of hardenable chromium stainless steels, or the cost of special non-ferrous metals.

With a typical ultimate tensile strength of 200,000 psi and corrosion resistance comparable to 18-8 stainless in many media, Armco 17-4 PH Stainless Steel offers unusual opportunities to improve the performance and lengthen the service life of many chemical processing units.

Resistance to Galling, Wear and Abrasion

By combining high hardness, up to Rockwell C 44, with excellent corrosion resistance, Armco 17-4 PH solves numerous galling, wear and abrasion problems. For parts exposed to corrosive media, this special precipitation-hardening stainless steel provides superior wear resistance and reduces galling much better than standard stainless grades or more expensive alloys.

Typical applications where Armco 17-4 PH Stainless results in longer maintenance-free operation and lower over-all costs include pump shafts, valve stems and trim, bolts and studs that must be removed frequently, wear rings, and thread inserts.

The unique properties of Armco 17-4 PH Stainless Steel yield valuable advantages for both the manufacturer and the user of chemical processing equipment. Let us send you more information on how this special stainless steel can benefit **you.** Armco Steel Corporation, 2750 Curtis Street, Middletown, Ohio.

New steels are born at Armco

☐ Send me complete information on Armco 17-4 PH Stainless Steel. I am particularly interested in it for the following applications:_____

☐ Send me your folder, "How Armco 17-4 PH Stainless Steel Guards Valve Parts from Corrosion, Erosion, Wear and Galling."

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Company_____

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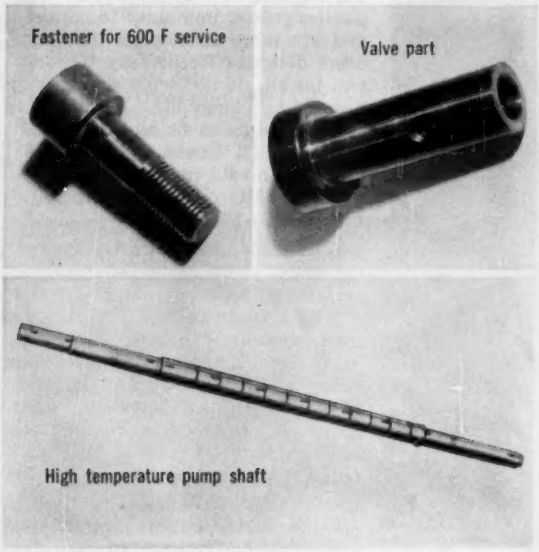
SOLVES PROBLEMS CHEMICAL EQUIPMENT

Adequate Strength at Elevated Temperatures



Elimination of Distortion and Scaling

Higher operating temperatures and stresses in chemical processing have created the need for metals that perform reliably under such severe conditions. With typical short-time ultimate strengths of 169,000 psi at 700 F and 149,000 psi at 900 F, plus excellent corrosion resistance, Armco 17-4 PH Stainless Steel has solved this problem in many chemical plant applications. At temperatures up to 1000 F, it has creep, stress-rupture and short-time tensile strengths superior to many of the standard stainless grades. Fasteners, valve parts, compressor and pump shafts, and instrument components are typical applications where 17-4 PH is especially useful.

Armco 17-4 PH Stainless Steel is hardened at only 900 F for one hour. This simple heat treatment does away with the troublesome distortion, cracking and scaling that occurs in heat-treating standard hardenable stainless grades or low alloy steels. Hardening 17-4 PH produces only a light heat tint that does not affect dimensional tolerances. Consequently, parts can be completely machined, then heat treated. Tempering, straightening, pickling and secondary finishing operations can be eliminated and rejection rates reduced. Important on any job requiring hardened corrosion resistant parts, these advantages become real money-savers on long shafts and complicated parts.

ARMCO STEEL

Armco Division • Sheffield Division • The National Supply Company • Armco Drainage & Metal Products, Inc. • The Armco International Corporation • Union Wire Rope Corporation

ENGINEERED TEFLON* PRODUCTS
for Chemical Processing

Processors find it good practice to apply Garlock Teflon Packings and Seals against hot, reactive chemicals.

Garlock LATTICE-BRAID† Teflon Packings are strong, long-lasting, chemically inert. Withstand temperatures ranging from −120°F to +500°F. Extremely effective in reducing maintenance . . . require less gland pressure to effect an adequate seal. This results in longer sleeve and packing life, less downtime. Because of the interlocking braid construction, LATTICE-BRAID Packings will hold together far beyond the limits of other packings. Catalog AD-131.

Garlock CHEMISEAL† Mechanical Seals possess greater immunity to corrosion and are more economical than most other designs offered. Easy to handle and install, do not score shafts, engineered for long life. Available in standard sizes to fit all pump shafts ⅞" to 2⅛". Seals against most corrosive media at pressures to 100 p.s.i. at 75°C or 75 p.s.i. at 100°C. Catalog AD-164.

Garlock Teflon-jacketed Gaskets give you the advantage of using Teflon without sacrificing resiliency and deformability . . . particularly important on your glass-lined process equipment, light metal flanges, and glass pipe flanges and fittings. Garlock offers four basic designs—slit envelope, milled envelope, formed shield, double jacket —and a wide selection of filler materials and thicknesses. Catalog AD-154.

Garlock Solid Teflon and Teflon-lined Expansion Joints guard costly piping against sudden pressure surges . . . reduce flange breakage, prevent stress, compensate for misalignment. Solid Teflon Expansion Joints can be used against solvents, acids and caustics to 75 p.s.i. Teflon-lined Expansion Joints are recommended for pressures from 60 p.s.i. to 125 p.s.i. depending on pipe size. Catalog AD-137.

GARLOCK

Discuss the sealing of corrosives with your local Garlock representative—he will be glad to offer suggestions and other application assistance you may need. For prompt service, call him at one of Garlock's 26 offices and warehouses throughout the U.S. and Canada. Or, write Garlock Inc., Palmyra, New York.

Canadian Div.: Garlock of Canada Ltd.

Plastics Div.: United States Gasket Company

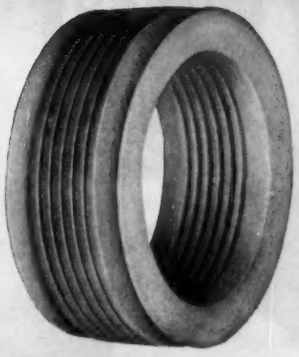
Order from the Garlock 2,000 . . . two thousand different styles of Packings, Gaskets, Seals, Molded & Extruded Rubber, Plastic Products

†Registered Trademark
*DuPont Trademark for TFE Fluorocarbon Resin

CHEMISEAL Mechanical Seals are in wide service on rotary shafts of equipment like reaction vessels and pumps.

LATTICE-BRAID Teflon Packings are used for rotary and centrifugal shafts, valve stems, and reciprocating rods, rams, plungers.

Solid-Teflon and Teflon-Lined Expansion Joints protect piping from pump, compressor, engine and pressure surges.



Teflon-jacketed Gaskets prevent leakage in glass-lined process equipment, light metal flanges, glass pipe flanges and fittings.

PENTON® COATINGS

A simple solution to your complex

CORROSION PROBLEMS

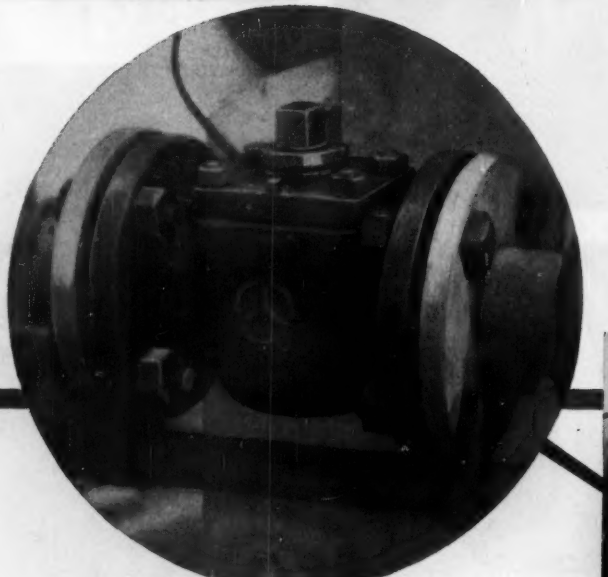
Though many corrosion problems may seem complex, a Penton coating can often supply a simple answer. Economically applied to low-cost metal substrates, Penton provides a rough, pinhole-free barrier against corrosion at elevated temperatures.

A typical example is this Penton-coated TUFLINE plug valve, successfully serving in the discharge and filling line of a 20-Baume muriatic acid installation where even expensive metals could not withstand the corrosive exposures involved.

Durable Penton coatings for valves, pipes and fittings, and pump and meter parts ranging in thickness from 10 to 40 mils, can be achieved by various techniques. They provide excellent protection against the corrosive attack of acids, alkalis and solvents, both to exterior surfaces and interior wetted parts.

Penton, chlorinated polyether, is a modern engineering material with an established record of success in combating today's toughest corrosion problems. Easy to mold or fabricate, it can serve as a coating or liner for metal, or be used in solid molded form.

Want to learn more about Penton? Write for your copies of "The ABC's of Penton for Corrosion Resistance," which cites data on Penton's chemical resistance to more than 300 reagents, and "The Penton Buyer's Guide," a complete listing of fabricators and suppliers of Penton processing equipment.



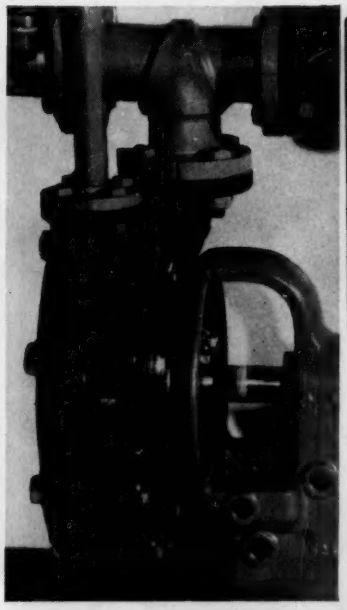
PENTON MAKES TUFLINE VALVES TOUGHER

Tufline valves in sizes from ½" to 2" with a PENTON-CORVEL* coating are made by Continental Manufacturing Company, Cincinnati, O.

**A custom coating applied by the Whirlclad system, a fluidized bed process patented by The Polymer Corporation, Reading, Pennsylvania.*

HERCULES POWDER COMPANY
INCORPORATED
Hercules Tower, 910 Market Street, Wilmington 99, Delaware

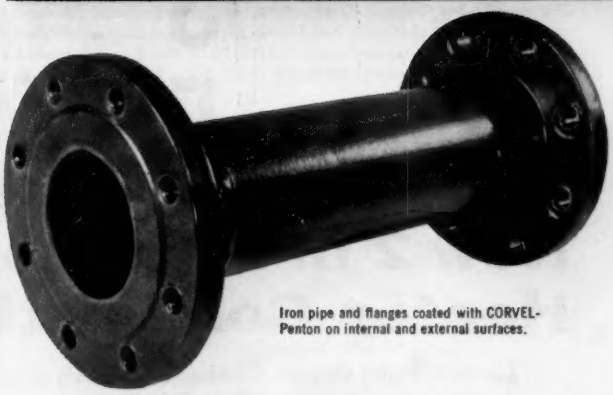
CP60-13



Protect your processing equipment from **corrosion** with **CORVEL®-Penton† Coatings**

▲ This pump has a 25 mil Penton coating applied by fluidized bed process to pump impeller and both the inside and outside of pump head, providing internal protection against corrosive fluids as well as an exterior surface finish resistant to corrosive atmosphere.
(PHOTO COURTESY GOULDS PUMP CO.)

Flowmeter coated with CORVEL-Penton provides high-order corrosion resistance for use in a wide variety of chemical atmospheres that attack metals. ▶
(PHOTO COURTESY BROOKS ROTAMETER CO.)



Iron pipe and flanges coated with CORVEL-Penton on internal and external surfaces.

WHIRLCLAD® Custom Coating Service

CORVEL-Penton provides ideal, high order corrosion protection for valves, pumps, flow meters, pipe and fittings in the chemical, food and other processing industries. Because of their excellent resistance to almost all acids, alkalis, solvents and chlorides, CORVEL-Penton coatings on low cost metals are unmatched in performance and economy . . . competitive in cost with low order corrosion protection.

Penton coatings operate in temperatures to 250°F. and over. The wear and abrasion resistance of the coatings imparts excellent durability to parts operating under corrosive conditions.

In Polymer's WHIRLCLAD custom coating service, Penton is applied to valves, pipes and processing equipment in the WHIRLCLAD coating system‡, utilizing a fluidized bed of dry, finely divided resin powders. The powders heat-fuse to form a uniform, continuous film with thorough coverage of edges, corners and projections on complex shapes. Pin-hole-free coatings are readily obtained in thicknesses of .010" and over. Coatings of vinyl, polyethylene, cellulosic, nylon and epoxy are also available.

- **Nationwide coating facilities**
- **Specialized application techniques**
- **Experienced engineering assistance**

WRITE FOR BULLETIN CP-1

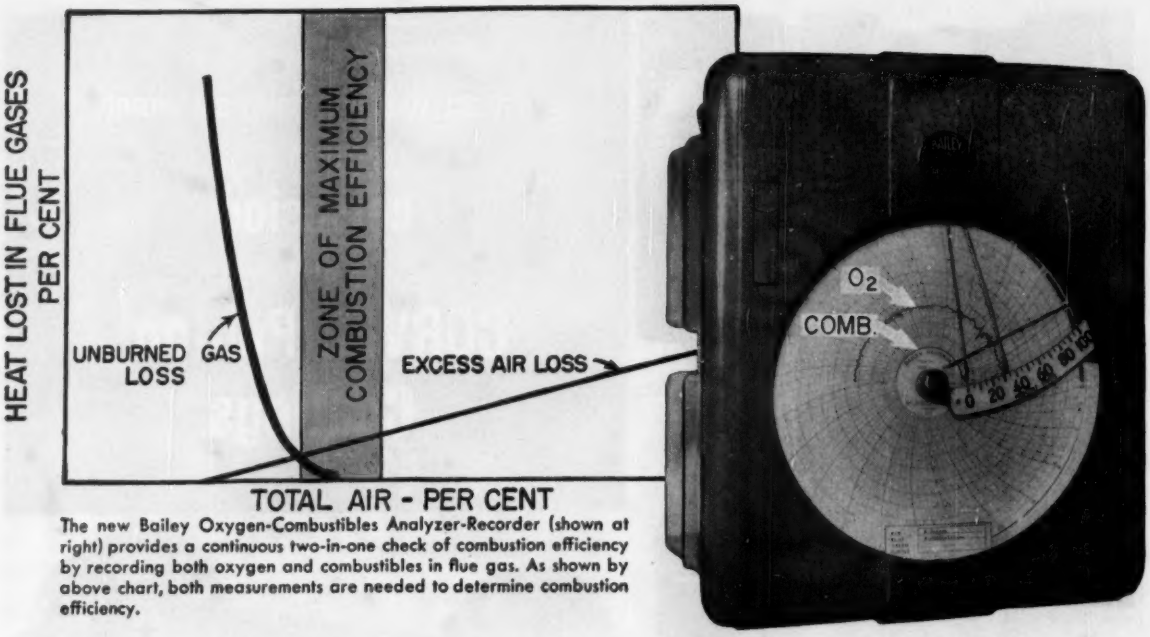
‡The basic fluidized bed process was developed and patented in Germany. Polymer's WHIRLCLAD coating system which encompasses the fluidized bed technique is protected by various apparatus and process patents in the United States and foreign countries and numerous applications are pending. Exclusive patents and licensing rights in the United States and Canada are owned by a subsidiary of The Polymer Corporation.

POLYPENCO *industrial plastics*

CUSTOM COATING SERVICE
WHIRLCLAD Division
The Polymer Corporation
Reading, Pennsylvania

Other Custom coating facilities: Santa Ana, California
Rolling Meadows, Illinois

†Trademark of Hercules Powder Co.



The new Bailey Oxygen-Combustibles Analyzer-Recorder (shown at right) provides a continuous two-in-one check of combustion efficiency by recording both oxygen and combustibles in flue gas. As shown by above chart, both measurements are needed to determine combustion efficiency.

BAILEY announces . . .
New 2 in 1 way to measure Heater Combustion Efficiency

The new Bailey Oxygen-Combustibles Analyzer-Recorder gives you a continuing double check on combustion economy. It's fast response measures and records:

1. Excess air—regardless of the fuel or combinations of fuels being burned.

2. The mixing efficiency of your fuel-burning equipment—by indicating the amount of combustibles in your flue gas, resulting from incomplete mixing of fuel and air.

Combustion efficiency depends upon fuel-air ratio. Too much fuel can be even more costly than too much air. And because of the interdependence of these two factors, no control that measures only one of them can give you complete protection.

Now, for the first time, you can check *both* with a *single* fast acting instrument, using the new Bailey Oxygen-Combustibles Analyzer-Recorder for industrial furnaces, kilns, heaters and boilers.

Fuel economy improves as excess air is reduced —until unburned fuel begins to show up in the flue gas. When this happens, combustion efficiency drops off sharply if there are further decreases in the air-fuel ratio. That's why combustion gases must be analyzed for *both* oxygen and combustibles to get a true indication of efficiency—and that is why Bailey coordinates both measurements on the same chart, to show when excess air may be reduced safely without danger of greater losses from unburned gases.

The Bailey Oxygen-Combustibles Analyzer is an approved combustion safeguard.

Ask your local Bailey engineer for suggestions on application. Equipment details in Product Specifications E65-1 and E12-5. CP107-1

Chemical and petroleum division

BAILEY METER COMPANY

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In Canada—Bailey Meter Company Limited, Montreal

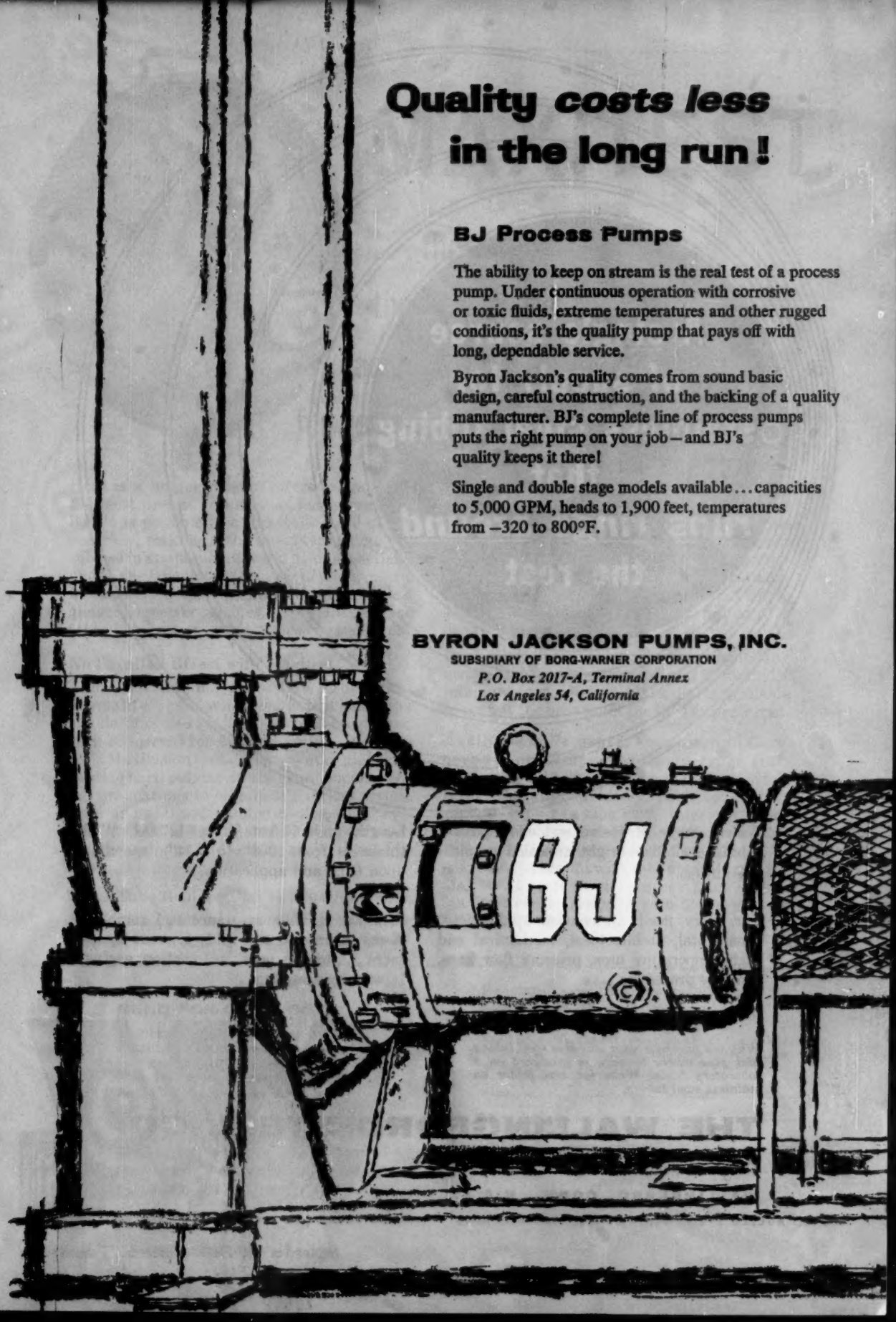
Quality *costs less* in the long run!

BJ Process Pumps

The ability to keep on stream is the real test of a process pump. Under continuous operation with corrosive or toxic fluids, extreme temperatures and other rugged conditions, it's the quality pump that pays off with long, dependable service.

Byron Jackson's quality comes from sound basic design, careful construction, and the backing of a quality manufacturer. BJ's complete line of process pumps puts the right pump on your job—and BJ's quality keeps it there!

Single and double stage models available... capacities to 5,000 GPM, heads to 1,900 feet, temperatures from –320 to 800°F.



BYRON JACKSON PUMPS, INC.
SUBSIDIARY OF BORG-WARNER CORPORATION
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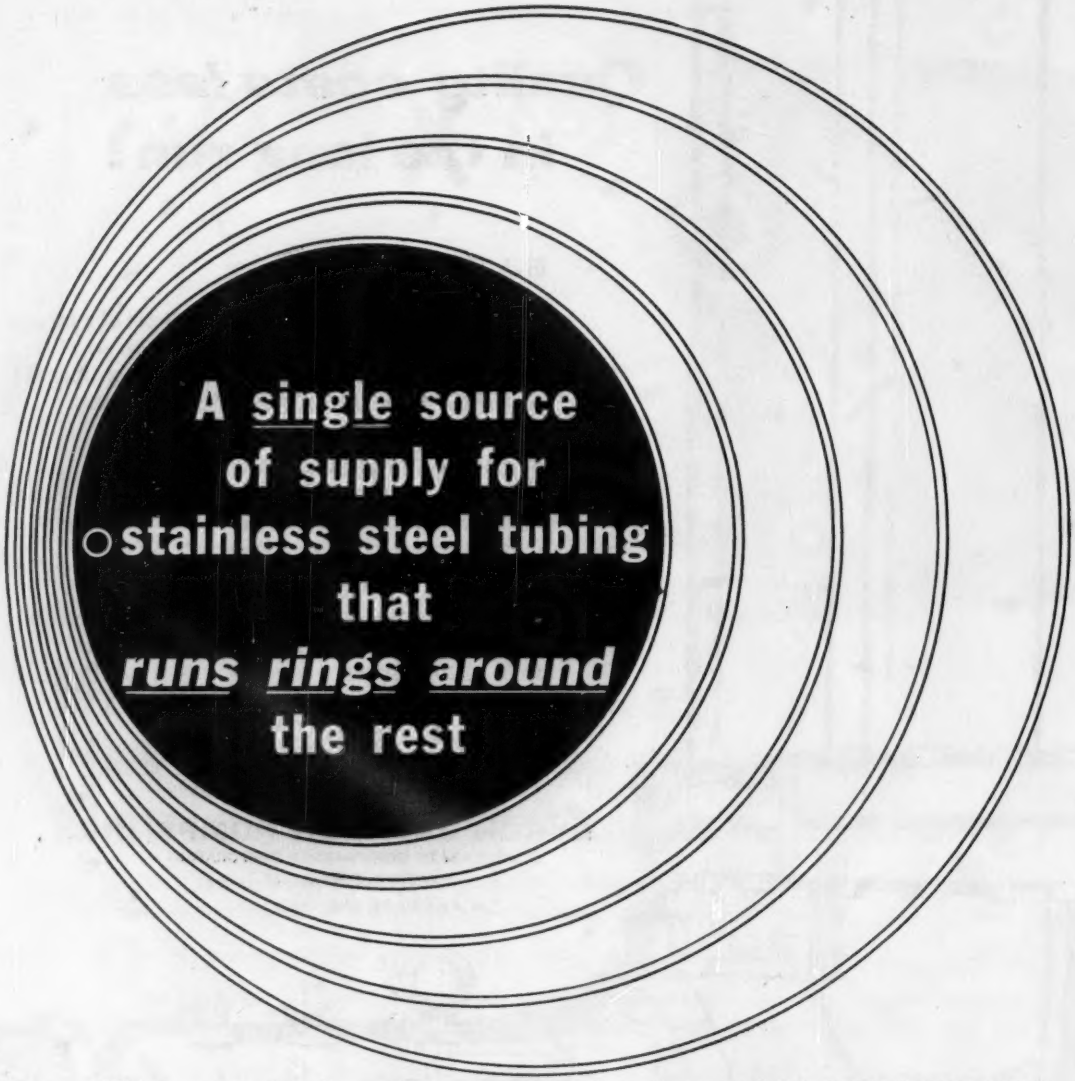
Los Angeles 54, California



Widest range of fusion welded pipe and tubing available—bright annealed or pickled finishes.

Lengths up to 60 feet. ⅛" to 6⅝" O.D. Wall thickness from .008" to .154" depending upon O.D. and application.

For every need . . . aviation applications, ornamental, architectural, mechanical and high-temperature uses, pressure flow lines, sanitary processing . . .

And for quality assurance . . . complete X-ray, ultrasonic and Eddy Current equipment . . . tensile tests, automation gaging, laboratory samplings.

Why not purchase your stainless steel tubing and pipe where tonnage is produced on a laboratory basis? Write for new folder on stainless steel tubing.

THE WALLINGFORD STEEL CO.

Progress in Metals for Over 38 Years

WALLINGFORD, CONN., U.S.A.

COLD ROLLED STRIP: Super Metals, Stainless, Alloy • **WELDED TUBES AND PIPE:** Super Metals, Stainless, Alloy

MAXITEST®

. . . the Ashcroft Gauge that gives you accuracy to 1/10 of 1% for testing other pressure instruments

Here is a unique master reference gauge of the most precise accuracy and easy readability. It is possible to calibrate to 1/10 of 1% accuracy, making it the finest test gauge you can use in maintenance work, field inspections, and in the laboratory. It is particularly useful in checking accuracy and calibration of test gauges, receiver gauges, transmitters, and other pressure-operated devices to 10,000 psi.

No Parallax Effect with Maxitest

The Maxitest has a durable lightweight Alumalife® case with convenient carrying handle. It is also available without handle and back connected for flush mounting. It has an 8½" Maxivision® dial—a two-level dial with needle-sharp pointer on the same plane as the tab graduations to eliminate parallax errors. Case and dial are painted contrasting "eye-rest" greens to assure surest, sharpest readability indoors and outdoors, without eye strain.

Metal Tabs Replace Dial Graduations

Adjustable metal tabs completely replace the usual printed major dial graduations. The standard number of graduation tabs supplied is determined by the psi scale range of the particular model desired. They are positioned near the outer circumference of the dial but can be precisely set individually to assure exact pressure reading at each point. (Up to 1/10 of 1%—the calibration standard of a deadweight gauge tester.)

Each tab is "hairline" marked to indicate any accuracy deviation—from ¼ of 1% to 1% of total dial graduation. A blank dial is available to permit the user to set the tabs as preferred.

Available in Pressure, Vacuum, and Compound Types—Total graduations range from 0/15 psi to 0/10,000 in pressure types with tab intervals appropriately assigned. 0/30" vacuum type has tabs at 2" intervals. Compound types have graduations 15 psi and 30" vacuum with tab intervals at 3 psi and 5"; 30 psi and 30" vacuum with tab intervals at 5 psi and 10". For testing receiver gauges, the Maxitest can be supplied with dial ranges of 3/15, 3/27 and 6/54 psi.

SEND FOR CATALOG

For complete information about the Maxitest or the complete line of Ashcroft test gauges and gauge testers, phone your industrial supply distributor—or mail the coupon for Catalog 300B.

MAXWELL MANNING M&M & MOORE INC. TRADE MARK

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A product of
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Send me complete information about the Ashcroft Maxitest and other test gauges, gauge testers, and service gauges.

Name_____

Title_____

Company_____

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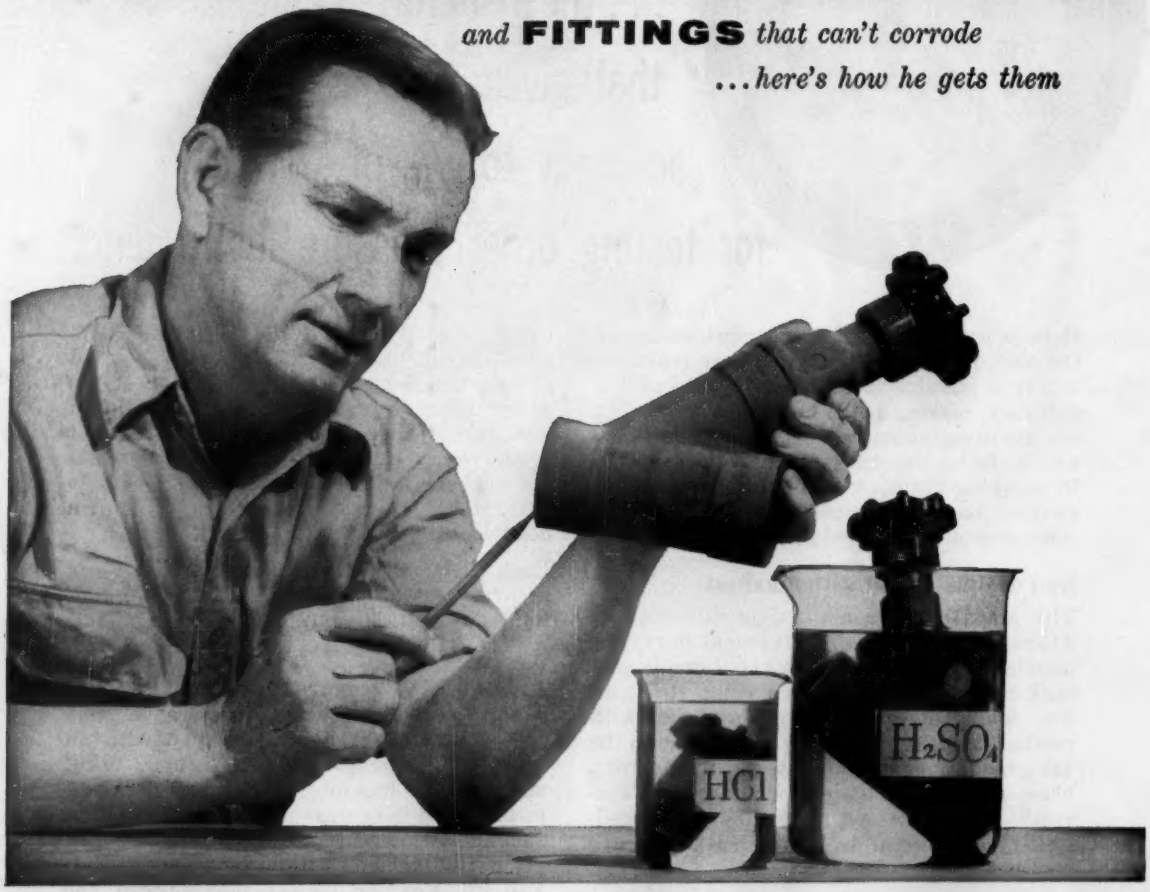
City/Zone_____ State_____

the **WALWORTH CUSTOMER** *wants* **PLASTIC VALVES** *and* **FITTINGS** *that can't corrode ...here's how he gets them*



When the Walworth Customer is faced with the control of corrosive fluids, he looks at dozens of plastic valves and checks them for himself. He demands answers to questions like these: Can this valve corrode? Is it toxic? Is it non-aging? In Walworth PVC Valves and Fittings, the Walworth Customer finds his answers. Not only is PVC nontoxic and non-aging, – it *can't* corrode. *All* parts are made of plastic. Valves and fittings have high burst strength. Given those facts the Walworth Customer buys.

That may be the way you like to buy valves, too. If you insist on knowing about materials, workmanship and high quality, we'd like you for a Walworth Customer, too. For the newest literature on the complete line of PVC Valves and Fittings, get in touch with your Walworth Distributor.

Or write **WALWORTH** *750 Third Avenue, New York 17, N. Y.*

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PROCTOR

introduces the "Newest Dryer Under the Sun"

THE SCL

Proctor's new, completely redesigned, single conveyor dryer . . . the S C L . . . promises a new day for drying . . . superior performance . . . at a *new low investment!*

Profit from these advanced **SCL** *features:*

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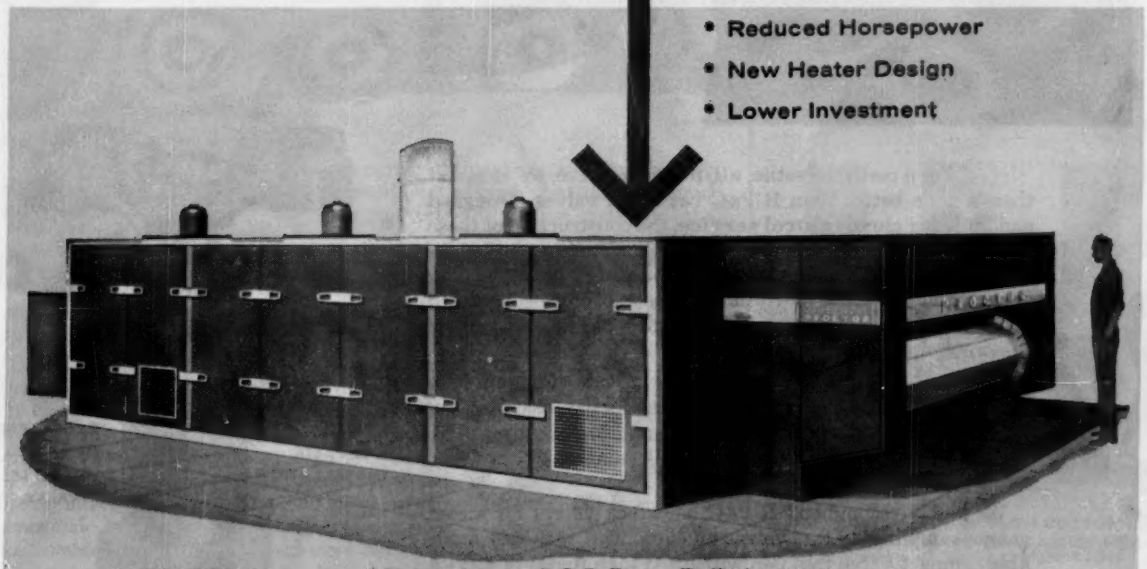
- More Compact Housing
- Tighter Housing
- Easier Cleaning
- Improved Air Circulation
- Reduced Horsepower
- New Heater Design
- Lower Investment



SEND NOW for a copy of Proctor's new S C L Dryer Bulletin . . . No. 462. It will pay you to know about the "newest dryer under the sun" . . . the S C L . . . by Proctor . . . of course!

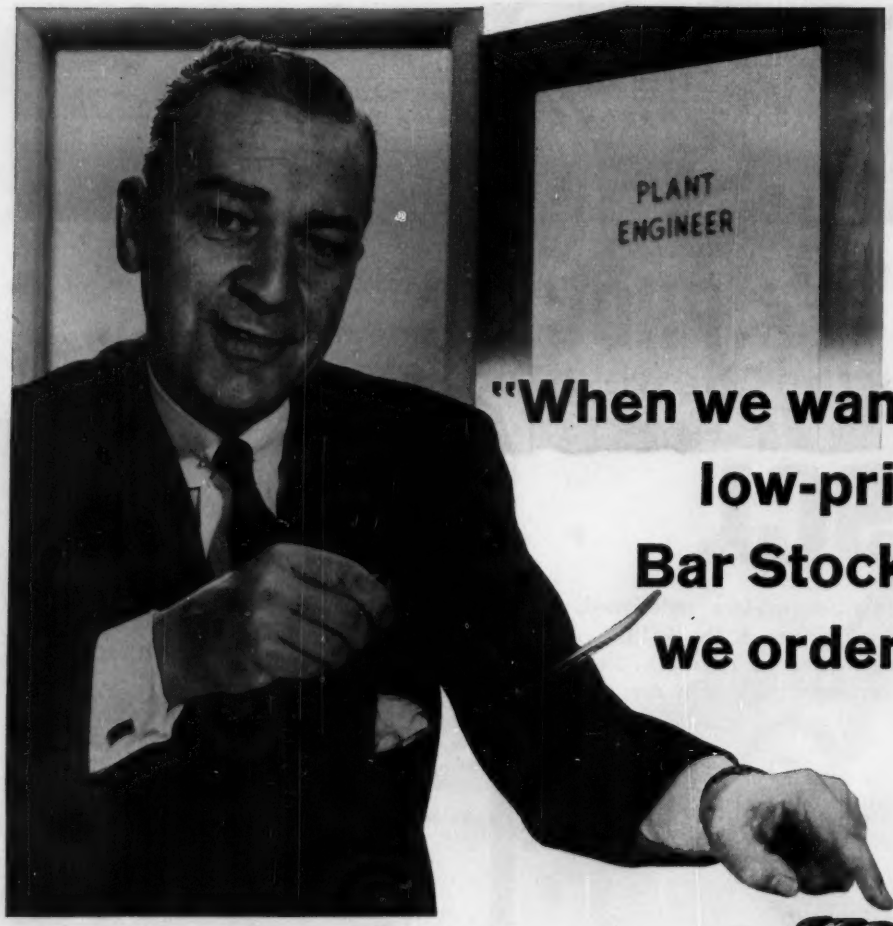
See our insert in Chemical Engineering Catalog.

Proctor®

PROCTOR & SCHWARTZ, INC.

Seventh Street & Tabor Road, Philadelphia 20, Pa.

MANUFACTURERS OF CONVEYOR DRYERS, SPRAY DRYERS, TRUCK DRYERS AND LABORATORY DRYERS FOR THE CHEMICAL INDUSTRIES AND OF QUALITY MACHINERY FOR THE TEXTILE INDUSTRY.



"When we want rugged, low-priced Bar Stock Valves we order R-P&C"

"For a really versatile, **all-purpose** valve, we've found there's none better than R-P&C bar stock valves. Designed and built **for close control service,** the construction of these valves makes them well suited to many general purpose applications as well. For example, the **compactness** of R-P&C bar stock valves is particularly advantageous for close-coupled installations in instrument lines or on panel boards and for pressures up to 10,000 lbs. in steel."

These valves are available in a wide variety of materials to withstand extremely high temperatures and pressures. But best of all, R-P&C bar stock valves are economically priced. This is made possible through special techniques developed by R-P&C.

We highly recommend R-P&C bar stock valves for meter, gauge, sampling, or test valves on equipment requiring a reliable compact valve that can withstand high pressure service.

Contact your R-P&C distributor for full details about bar stock valves in bronze, carbon and stainless steels plus the complete line of R-P&C gate, globe and angle valves in all standard materials.

R-P&C VALVES

ACCO

R-P&C Valve Division, American Chain & Cable Company, Inc.

Reading, Pa., Atlanta, Boston, Chicago, Denver, Detroit, Houston, New York, Philadelphia, Pittsburgh, San Francisco, Bridgeport, Conn.

ACTUAL TESTS* PROVE

Allen-Bradley Standard Duty Push Buttons can be installed

in about half the time!

In accurately timed tests, Allen-Bradley standard duty push buttons required *about half the installation time*—on the average—than each of four other popular makes. This saving in installation time means "dollars" saved on the job.

How come only famous A-B standard duty push buttons possess this time and moneysaving advantage?

The answer lies in the molded, wrap-around cover—which also contains the contacts. When the cover is removed, the wiring terminals are *out in the open*—ready for wiring—and you have plenty of working space. The two cover screws are captive—they cannot fall out and get lost. And with the contacts in the cover, they are protected against accidental damage and careless wiring. Naturally, these push buttons have double break, silver contacts that never need service attention. There are two concentric knockouts on each end of the base, which are removed from the *outside*—the heavy, pressed steel base will not bend out of shape.

Your local A-B distributor has these Bulletin 800 push buttons *in stock*. Call him today—you'll save time and money on your next job.

**Using recognized standard duty push buttons, installations were made by an experienced electrician under identical conditions. He was not connected with Allen-Bradley Company in any manner.*

A-B STANDARD DUTY PUSH BUTTONS
Made as a one-, two-, or three-unit station—with pilot light available. Readily changed for horizontal or vertical mounting. Convertible two- or three-way selector switch supplied with or without pilot light.

ALLEN-BRADLEY
Member of NEMA

QUALITY MOTOR CONTROL

REPUBLIC VECTOR CONTROLLERS FEATURE 2 TO 500% PROPORTIONAL BAND ADJUSTMENT

Rockwell-Built Republic vector controllers feature easy proportional band adjustment from 2 to 500%, an adjustable reset rate from 0.1 to 50 repeats per minute and less than 0.05% dead band.

This is typical of the performance of Republic's new Null-Balance-Vector line of pneumatic instruments which includes:

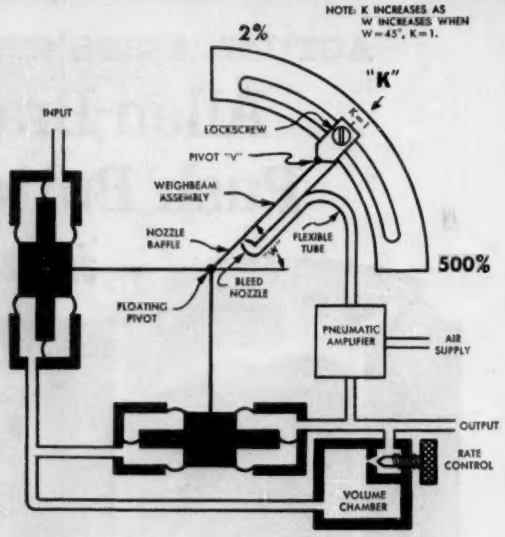
- Temperature transmitters with a 10 to 1 range adjustment.
- Pressure transmitters of 0.5% accuracy, 0.1% sensitivity.
- Differential pressure transmitters with a 20 to 1 range adjustment.
- Relays which extract square root down to 10% of output span.
- Multiplying, squaring, additive, totalizing, and ratio relays.
- Other instruments necessary for measuring, controlling, and computing variables for combustion and process industries.

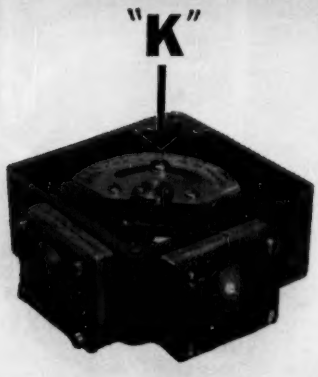
The span ("K") of each Republic Null-Balance-Vector instrument can be easily varied by loosening the lock-screw and sliding the weighbeam assembly along the slot as shown in the schematic. Zero does not have to be reset and only a comparison reference is required.

A common component, containing the "K" adjustment as illustrated, is the base around which each Republic Null-Balance-Vector instrument is built. This common "heart" means that you have interchangeability of parts—even among instruments performing different functions. Conversion and replacement parts can be pooled instead of stocking spare instruments for each control function.

In addition, you benefit from simplified operating and maintenance training because the same principle of operation is used for all instruments. All Republic Vector instruments are compact, lightweight and rugged. The Republic Engineer in your area will be glad to work with you on any control or measurement application. Or, write for information to Republic Flow Meters Company, Subsidiary of Rockwell Manufacturing Company, 2240 Diversey Parkway, Chicago 47, Illinois. In Canada: Republic Flow Meters Canada Ltd., Toronto.

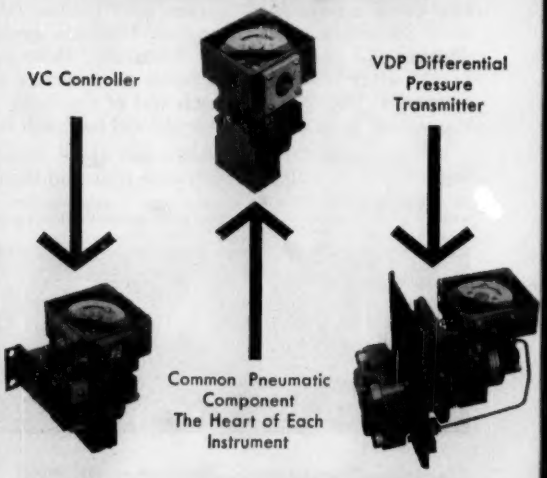
REPUBLIC INSTRUMENTS AND CONTROLS
more fine products by
ROCKWELL





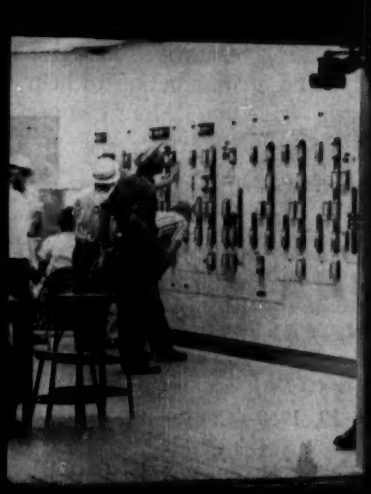
This is the common component around which each Republic Null-Balance-Vector pneumatic instrument is built. This component contains the "K" adjustment.

TYPICAL REPUBLIC NULL-BALANCE-VECTOR INSTRUMENTS



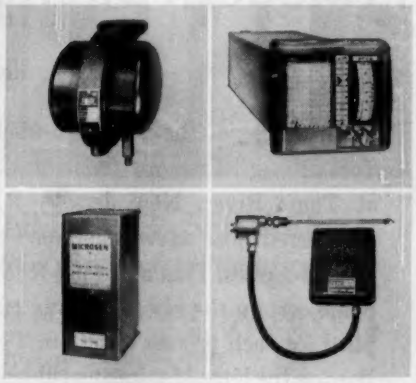
12:30 A.M.

Everything's under Control!



ROBERTSHAW
MICROSEN

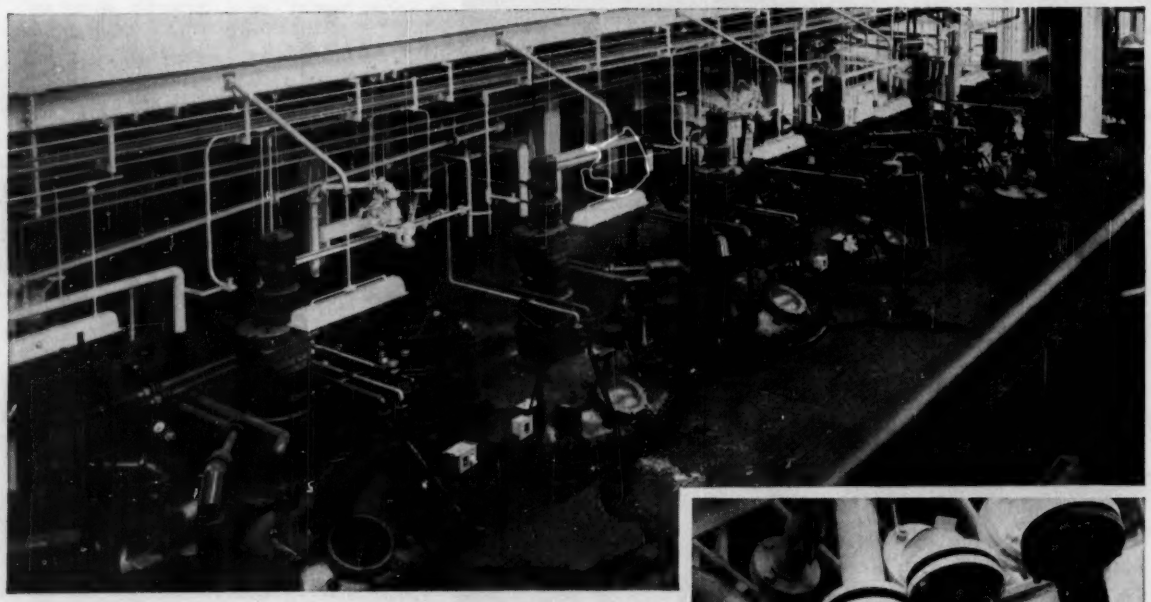
All's right at half after midnight.
The new shift settles in to monitor the processing steps. Meanwhile, out among the towers, Robertshaw-Microsen® Electronic Systems are providing maximum automation for data acquisition, transmission, recording and control of process variables. It's a typical job for Robertshaw—keeping everything under control. For greater system flexibility, lower initial investment and minimum operating costs—specify Robertshaw-Microsen for precision control of pressure, temperature, differential pressure, oxygen concentration, liquid level, gas analysis, pH, flow. Over 50 sales-service offices—write for address of the one nearest you—and for Technical Bulletin 10, entitled "Process Instrumentation."



Shown above: (Top, l. to r.) Microsen Transmitter, Microsen Recording Controller. (Bottom) Microsen Transmitting Potentiometer, Level-Tek Level Detection and Control System.

Robertshaw
MR. CONTROLS

Aeronautical and Instrument Division
Robertshaw-Fulton Controls Company,
Santa Ana Freeway at Euclid Avenue
Anaheim, California



R/M RUBBER HOSE
Helps Hold Costs *Down*
in Modern Chemical Plants

For example, at the new ultra-modern plant of Toms River—Cincinnati Chemical Corporation at Toms River, New Jersey—R/M custom-engineered hose saves manhours and protects vital processes. That's because R/M engineering made certain the *right* hose was made and supplied for each process function. Typical are the lines on the huge Manhattan rubber lined kettles shown above. The lengths of hose at right are specially engineered and equipped with leak-proof Hydro-Lok flanges to overcome process pipe-line problems. Throughout the Toms River plant, R/M hose constructions meet specialized job requirements handling corrosive chemicals and similar process solutions.

You can expect the same "engineering" with the R/M hose you specify for your plant. Easy handling Homoflex is ideal for wash-down operations, or wherever you use air or water hose for general service. For handling chemicals and acids, there's R/M Teflon Lined Hose and Condor Acid Hose available with rubber, neoprene, Butyl or Hypalon tube as required for specific conditions. Condor Flexible Pipe can outlast iron or steel as much as 10 to 1 for highly abrasive or corrosive solutions. R/M Rubber Expansion Joints will eliminate pipe-line stresses, misalignment and vibration.

Depend on your R/M representative to suggest the engineered R/M hose construction to help you hold costs down—give you "More Use per Dollar" on every job.

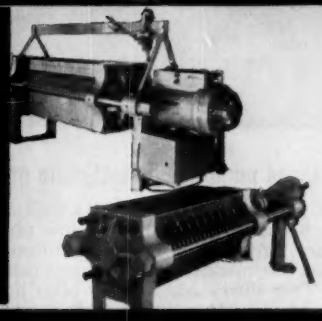
RM 1011

ENGINEERED RUBBER PRODUCTS ... MORE USE PER DOLLAR

RAYBESTOS-MANHATTAN, INC.

MANHATTAN RUBBER DIVISION, PASSAIC, NEW JERSEY

THIS IS sperry total filtration



A COMPLETE RESEARCH AND ENGINEERING SERVICE

. . . Geared to the filtration needs of all industry!

In its Batavia (Ill.) and Yonkers (NY) laboratories, a staff of Sperry specialists are actively engaged in technical service and filtration research. A large backlog of Sperry experience stands by for directional guidance.

From this firm footing comes the engineering that distinguishes the entire Sperry line. SPERRY FILTER PRESSES: All styles and sizes, with center, side or corner feed; open or closed delivery; simple or thorough washing; high or low temperature controls. SPERRY CLOSING DEVICES: In 8 models including the hand operated HANDRAULIC and popular EHC-L Electric models. SPERRY FILTER MEDIA: All types, all sizes, all material. Plain or punched to your specifications.

This is Sperry Total Filtration. Broad in scope, specific in application. Put it to work on the solution of your particular filtration problem. Write today. Or mail coupon for your free Sperry catalog.

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City_____

PUMPAGE

Goulds news about pumps for process industries

Glassed pump keeps tattletale gray out of light bulbs

Sylvania Electric Products Co. uses an abrasive slurry of hard fine phosphor particles in a xylol solution to coat the inside of its fluorescent tubes.

This slurry has always been hard to handle. It quickly eroded metal pumps which then contaminated and discolored the slurry. Discoloration increased rejects. A pneumatic system was tried . . . it needed constant monitoring and created a vapor hazard.

Sylvania engineers installed a Goulds-Pfaudler test pump, estimating a nine-month life would pay for the pump. *Over two years later*, the pump shows no wear or foreseeable future problems.

Sylvania now has four Goulds-Pfaudler glassed pumps, each running about 80 hours per week and handling 30 gpm of slurry against a 30-ft. head.

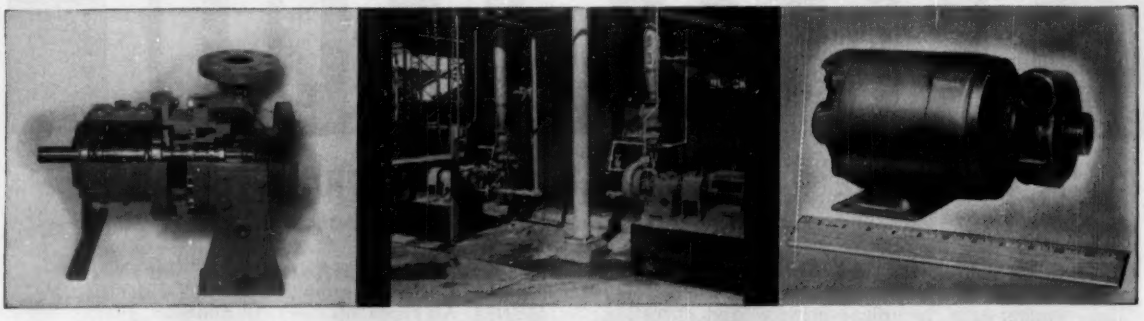
This simple, completely enclosed system ends vapor hazard, involved pipes and controls, and the need for constant monitoring. The inert glass protects product purity.

The ductile iron difference

To make ductile iron, magnesium is added to molten cast iron, changing the sharp, thin graphite flakes to spheroids. The spheroids have large areas of iron matrix between them, and since they have no sharp edges, the ductile iron has far greater strength than the original cast iron.

Ductile iron is so tough it can be used in many applications previously requiring cast steel.

It might pay you to look into this. Write us for information on ductile iron pumps or parts.



Pump with cold feet

The Goulds Model 3775, available in steel and any of the stainlesses, handles temperatures to 600° F because of its cooled support, bearing and seal chamber construction.

It is ideal for handling flammable or otherwise dangerous liquids, withstands thermal shock.

For information on this, or other products on this page, write Goulds Pumps, Inc., Dept. CE-90, Seneca Falls, N. Y.

Vicious viscous kept moving

Over 100 Goulds pumps do a wide variety of pumping jobs at Marathon Southern Corporation.

Among them are two tough 3715's. These keep abrasive, viscous black liquor moving. Each handles 200 gpm to a head of 65 ft. Stainless steel 316 construction resists the bite of hot, abrasive liquor.

Choose construction materials best suited for you when you get the Model 3715. Write for Bulletin 725.4 which lists available materials.

Now... circulate with Hastelloy "C"

If you need a small pump in a hurry to circulate or transfer clear corrosives—we can supply it right off the shelf.

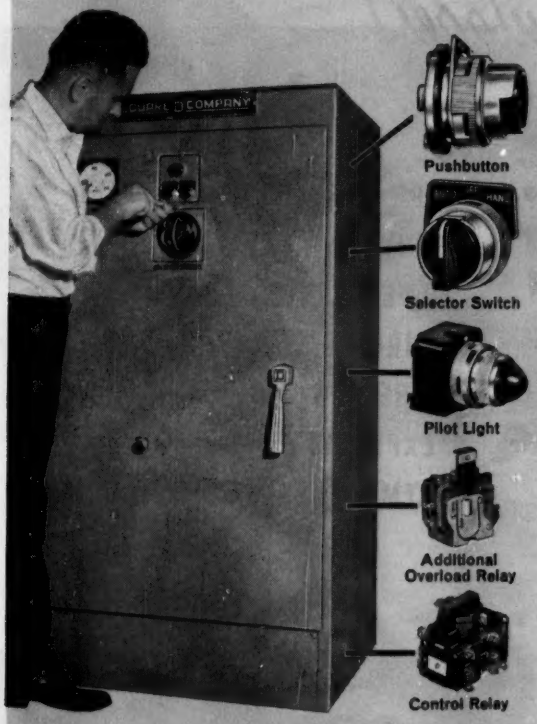
Hastelloy* "C," a highly corrosion-resistant nickel-chrome-molybdenum alloy, is now available on our Model 3604. This ¾" centrifugal pump with big-pump stamina is built for 'round-the-clock service in chemical process work, pilot plant or laboratory.

Drop us a line and we will send you a bulletin with performance chart and other information.

*Trademark of the Haynes-Stellite Division of Union Carbide Corp.

GOULDS PUMPS

FAST DELIVERY of SIZE 6, 7 & 8 STARTERS



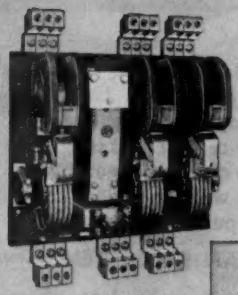
PRE-ENGINEERED MODIFICATIONS eliminate Special Engineering

Square D NEMA Size 6, 7 and 8 magnetic starters are now built with a plate in the door to accommodate modifications when needed. The same modifications which have long been available on Square D starters through Size 5—pushbuttons, selector switches, pilot lights, additional overload relays, auxiliary contacts—can now be added to the larger starters without special engineering.

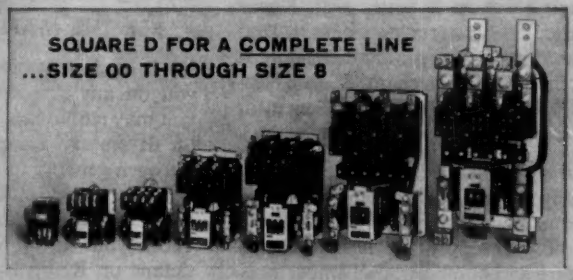
This means fast processing of your order, quick delivery of your starters. What's more, you can make the same modifications in the field. The wiring diagram shipped with each starter shows exactly how to do it.

Available in ratings up to 900 hp, Square D Size 6, 7 and 8 starters can be ordered as open devices, or in general purpose, dust-tight and water-tight enclosures.

• With Square D Size 6, 7 and 8 starters, you get DC-operated (self-contained DC supply) mill-type contactors—at no extra cost. Exclusive Line-Arc construction dissipates heat, provides longer contact life. Self-lubricating bearings plus simple design make maintenance extremely easy. Another standard feature is lugs which accommodate either copper or aluminum cable.



• The magnetic starters shown at right—which range from Size 00 through Size 5—plus the Size 6, 7 and 8 starters described above, add up to a *complete* Square D line for *any* AC motor application.



Write for Bulletin 8536. Square D Company, EC&M Division, 4500 Lee Road, Cleveland 28, Ohio

SQUARE D COMPANY

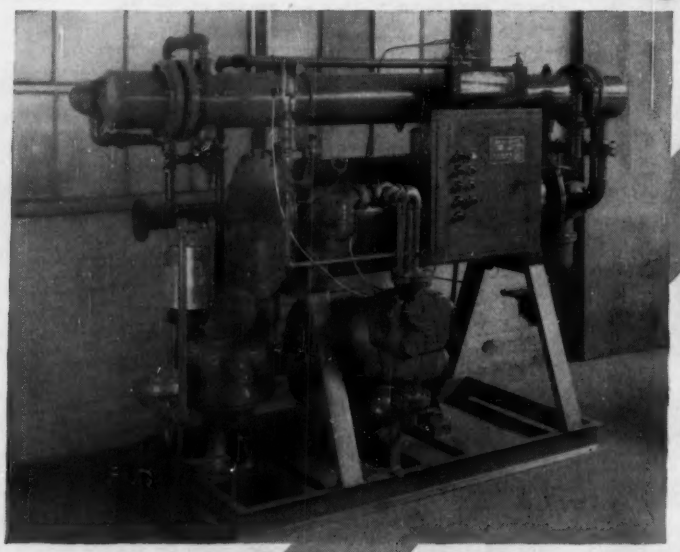
EC&M DIVISION • CLEVELAND 28, OHIO

wherever electricity is distributed and controlled

5291

KEMP INERT GAS GENERATORS

give you 4 basic advantages!



FOR BLANKETING
AGITATING
O_2 EXCLUSION
PURGING
FIRE AND
EXPLOSION
ATMOSPHERES

1 **Constant analysis** is automatic due to the exclusive Kemp Carburetor that pre-mixes gas and air in precisely the ratio you desire . . . maintains it regardless of total demand or pressure fluctuation in the supply line.

2 **Easy start-up** is yours with Kemp Carburetor and external test burner. You test the pre-mixed gas-air ratio *before* it enters the combustion chamber. And electric ignition gets your Kemp Generator off to a time-saving, labor-saving start.

3 **Safety controls** effectively end flame-out danger. Kemp's electronic flame failure control instantly and automatically cuts off gas supply to the carburetor. Moisture and combustion chamber pressure cannot affect this control.

4 **Set it—forget it.** Once you've set the vernier dial on your Kemp Generator you can walk away and forget about it. Kemp's exclusive carburetor keeps your exact gas-air ratio coming hour after hour —as long as you wish—without further checking or manipulation of controls.

SEE THE MAN FROM KEMP

He is equipped and qualified to advise you on any size and type of generator you may require . . . can also counsel you on dryers and compressors for inert or nitrogen generation systems and heaters. See your C.E.C. Catalog for full listing of Kemp representatives in your area or check your local telephone book. For details on Kemp Inert Gas Generators, write for Bulletin I-10.

It always pays to come to

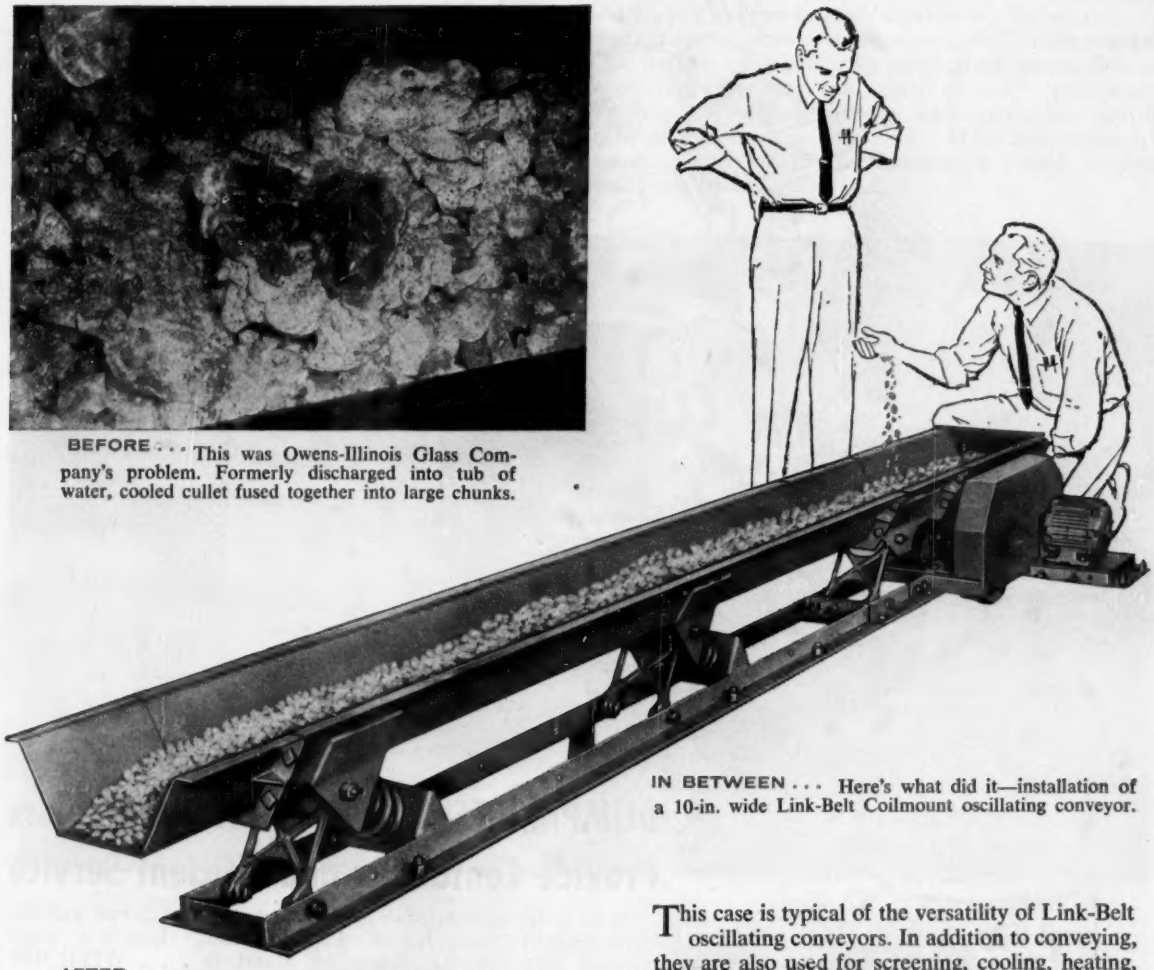
KEMP
OF BALTIMORE

THE C. M. KEMP MANUFACTURING COMPANY
405 E. Oliver St., Baltimore 2, Md.

LINK-BELT oscillating conveyor

smooths out production lumps

BEFORE . . . This was Owens-Illinois Glass Company's problem. Formerly discharged into tub of water, cooled cullet fused together into large chunks.



IN BETWEEN . . . Here's what did it—installation of a 10-in. wide Link-Belt Coilmount oscillating conveyor.

AFTER . . . Here's how cooled cullet looks now. Note small pieces and granules. No buildup of large chunks.

This case is typical of the versatility of Link-Belt oscillating conveyors. In addition to conveying, they are also used for screening, cooling, heating, drying, elevating and many other duties.

Under any operating conditions, they operate smoothly, unaffected by surge loads. The combination of *Positive Action* and *Natural Frequency* provides constant conveying under all conditions.

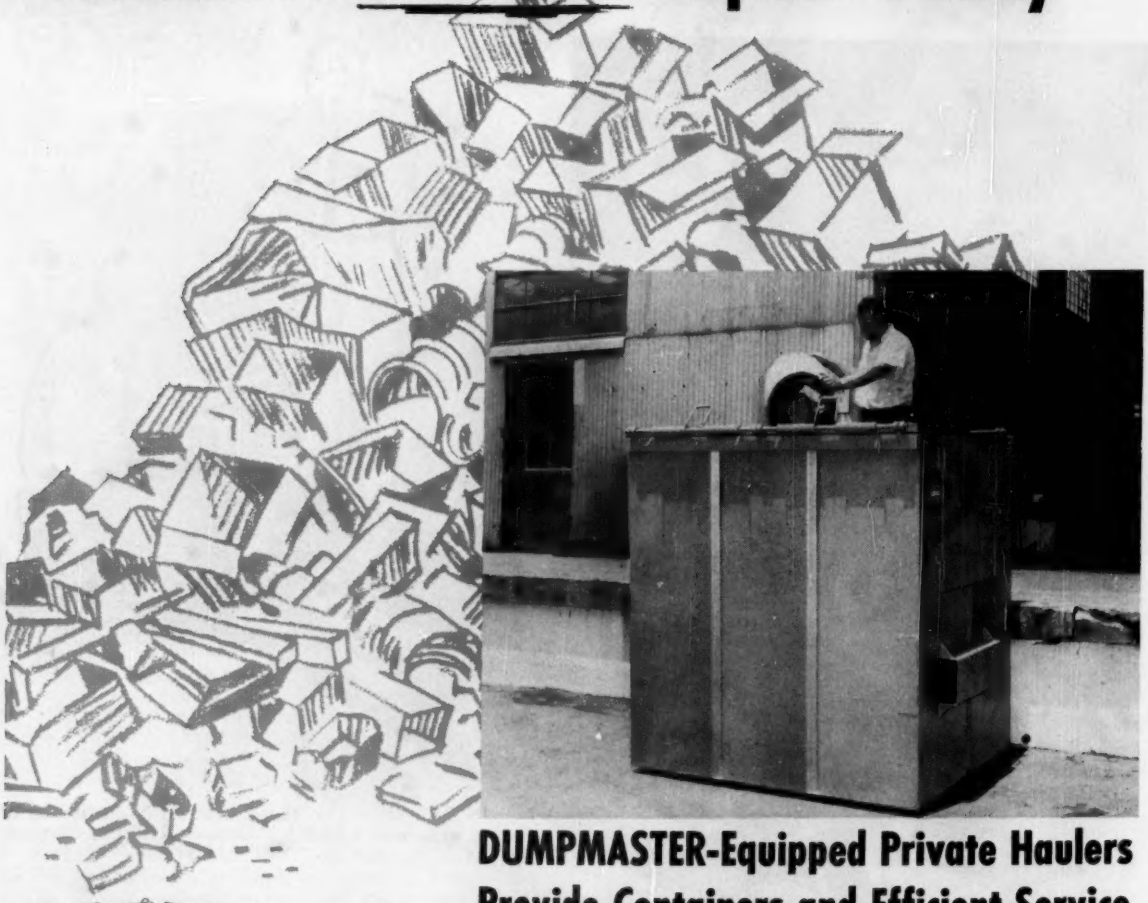
Pre-assembled sections of Coilmount conveyors can be delivered immediately from stock. Write for complete details, or see your authorized stock-carrying distributor. Ask for a copy of Book 2744.

LINK-BELT

OSCILLATING CONVEYORS

LINK-BELT COMPANY: Executive Offices, Prudential Plaza, Chicago 1. To Serve Industry There Are Link-Belt Plants, Warehouses and District Sales Offices in All Principal Cities. Export Office, New York 7; Australia, Marrickville (Sydney); Brazil, Sao Paulo; Canada, Scarboro (Toronto 13); South Africa, Springs. Representatives Throughout the World. 15,304

NOW! You Can End Refuse Storage Problems...WITHOUT Capital Outlay



IN ALL LEADING CITIES
FROM COAST TO COAST

DEMPSTER DUMPMASTER®
Equipped Private Haulers

DUMPMASTER-Equipped Private Haulers Provide Containers and Efficient Service

If you're plagued with trash piles, scattered refuse, fire hazards, and hit-or-miss collection, there's a good chance you can do something about it . . . WITHOUT CAPITAL OUTLAY!

In most major cities DEMPSTER-DUMPMASTER-equipped private haulers will put clean, big-capacity storage containers at convenient locations in your plant . . . empty them mechanically on schedule, or on a call-in basis . . . all for a reasonable monthly fee.

When you containerize your refuse, plant housekeeping becomes easy, employee morale goes up.

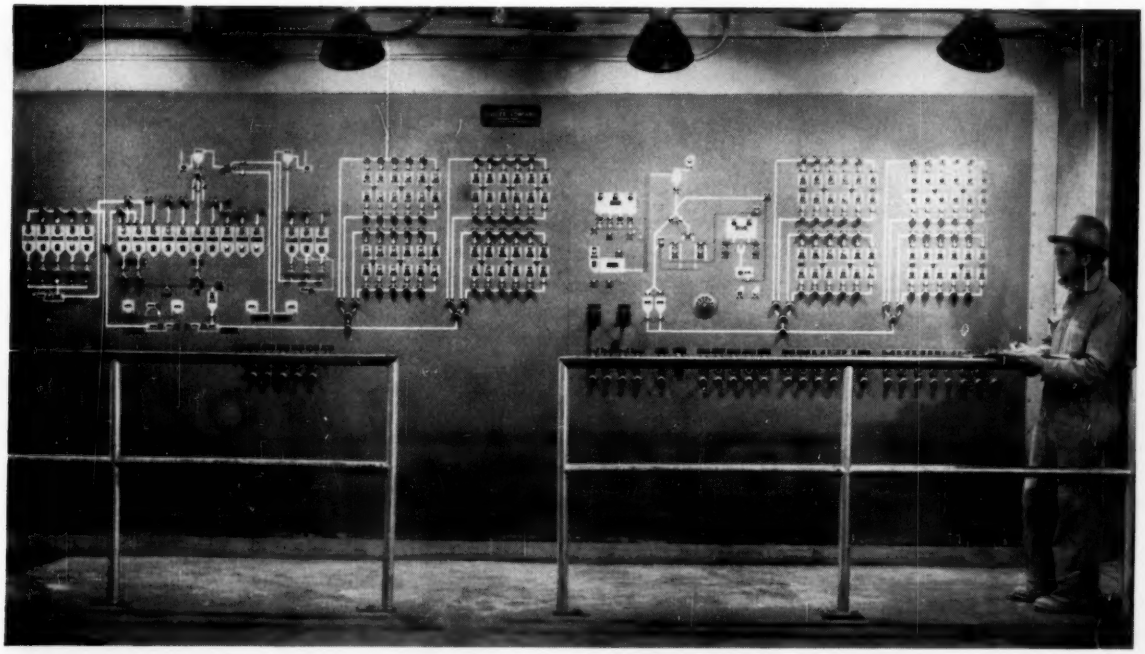
Write today for the name of your nearest private hauler. We'll also send literature describing his service.

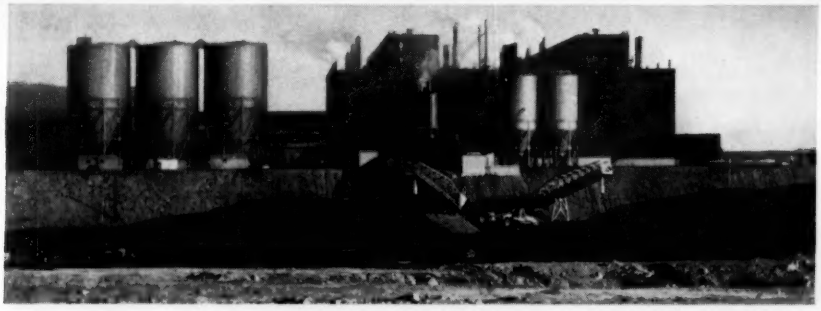
Write Today for
Free Brochure and Name of Nearest Private Hauler
DEMPSTER BROTHERS
Inc.
Dept. CE-9 KNOXVILLE 17, TENNESSEE

More "PAY-DIRT" With Fuller Panels In Control

One man on watch—and a Fuller Control Panel in control. Result: the flow of bulk, dry materials in a pneumatic conveying system graphically illustrated by diagrams and indication lights that track process transitions from phase to phase—without human errors!

Fuller Control Panels—automatic, remote, one-man control of multiple operations—stem from Fuller's vast materials handling and instrumentation experience. Fuller, the only manufacturer of pneumatic conveying equipment engaged in engineering and building its own control panels, puts its cumulative experience into each project. This single knowledgeable responsibility for both system and control means savings in time and costs. More important—it's your assurance that the total system is generic to your specific operational needs.





Look to Fuller's engineering-manufacturing team to develop the simplest possible control system without costly duplication or changes for you. Write for Bulletin G-9, today.

2635
CP-2

FULLER COMPANY
GENERAL AMERICAN
TRADE MARK

FULLER COMPANY
134 Bridge St., Catasauqua, Pa.
Subsidiary of General American Transportation Corporation
Offices in Principal Cities Throughout the World

Fuller
....pioneers in harnessing AIR

BONUS

from the Boiler

POWER

Capital of the World

THE TITUSVILLE-ATLAS

BONUS POWER means maintained high efficiency . . . longer life . . . less maintenance . . . more horsepower per total energy input. That's what you get when you install a complete TITUSVILLE-ATLAS unit, the only boiler with a patented wet back.

Wet-back design gives you maintained efficiency by eliminating back end refractories. *Result:* no down time for replacement.

Larger furnace area permits reduced fan requirements. *Result:* lower operating costs. Get BONUS POWER. Specify TITUSVILLE-ATLAS.

THE TITUSVILLE IRON WORKS COMPANY

TITUSVILLE, PENNSYLVANIA

Division of Struthers Wells Corporation

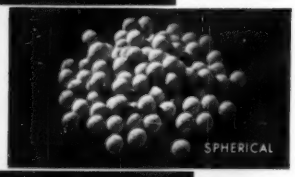
VMA-6958

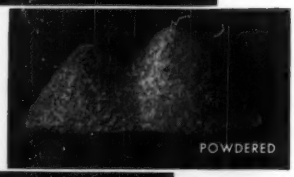
HARSHAW

typical

HARSHAW CATALYSTS

and how they are used





• DEHYDROGENATION CATALYSTS

CHROME-ALUMINA—available in powder or tablet form containing various percentages of chromium oxide supported on high surface area alumina—can be supplied as promoted catalyst and is also available as screened granules.

IRON—tableted iron oxide.

• REFORMING CATALYSTS

MOLYBDENA-ALUMINA—supported molybdenum oxide on alumina—available as microspheres for fluid techniques, or as tablets for fixed bed application.

NICKEL-ALUMINA—a spherical catalyst available as hard spheres measuring ¼″ to 1″ diameter—used for some types of gas reforming.

• DESULFURIZATION CATALYSTS

COBALT MOLYBDATE—a supported cobalt oxide—molybdenum oxide catalyst supplied in tablet form.

ZINC OXIDE—a pelleted zinc catalyst used in the desulfurization of natural gas.

MOLYBDENUM SULFIDE—powdered and tableted molybdenum sulfide.

• CHLORINATION CATALYST

COPPER—supported copper catalyst prepared and shipped as tablets or granules.

• HYDROGENATION CATALYSTS

NICKEL-KIESELGUHR—supplied as unreduced, or reduced and stabilized, tablets, ⅛″ to ⅜″ diameter.

NICKEL-ALUMINA—available in tablet form containing nickel as nickel oxide on high surface area alumina, or in spherical form supported on low area, high-fired alumina.

RUFERT FLAKES—reduced nickel protected by hardened oil shipped as free-flowing flakes for hydrogenation of all glyceride and acid fats.

COPPER-CHROMIUM OXIDE—shipped as powder or tablets, stabilized or non-stabilized, with varying ratios of copper oxide to chromium oxide.

NICKEL-ALUMINUM—powdered 50:50 alloy used for preparation of active nickel catalyst for low temperature hydrogenation.

• CATALYSTS FOR ORGANIC SYNTHESES

SODIUM METHYLATE—Powder and solution

ZINC CHROME—a tableted zinc oxide—chromium oxide catalyst used in the synthesis of methanol.

MERCURIC CHLORIDE—a granular catalyst consisting of mercuric chloride on active, granular carbon used in the synthesis of vinyl chloride monomer.

COBALT THORIA—available as powder or tablets, a thoria promoted cobalt catalyst employed in Fischer-Tropsch synthesis.

COBALT—a supported cobalt catalyst in pellet form used in the synthesis of hydrogen sulfide.

• DEHYDRATION CATALYST

ALUMINA—powdered and tableted aluminum oxide supplied as an active, intermediate surface area catalyst.

• CUSTOM CATALYST

Whether your requirement is measured in tons or pounds Harshaw can produce in confidence your catalyst exactly to your specifications of raw materials, chemical composition, and physical properties such as length, diameter, crushing strength, abrasion resistance, and bulk density. AND, make delivery when you want it. Call on Harshaw today—for further information or technical assistance.

Write for FREE booklet, "HARSHAW CATALYSTS"

THE HARSHAW CHEMICAL CO.

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Chicago 32, Ill. • Cincinnati 13, Ohio • Cleveland 6, Ohio • Detroit 28, Mich.
Hastings-On-Hudson 6, N.Y. • Houston 11, Texas • Los Angeles 22, Calif.
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THE ECON-O-MISER BALL VALVE...

The most advanced replacement valve for ON-OFF applications

Engineered design simplicity provides superior performance plus real dollar savings. • Remove 4 bolts—the center section lifts out—unions are eliminated. Service time and cost are reduced to a matter of minutes and pennies, and the valve is right back in operation. Costly spare parts are a thing of the past. • The Econ-O-Miser Ball Valve answers thousands of difficult application problems—simply—efficiently. Available from ¼″ through 6″ size range, it is ideally suited to difficult media, because of its smooth round flow and quarter-turn operation. • If you're interested in valves, you're interested in the Econ-O-Miser Ball Valve. Complete, up-to-date technical information is yours for the asking.

WORCESTER VALVE CO., INC.

16 PARKER STREET, WORCESTER, MASS.

NO UNION NECESSARY!

Quality control is a relentless task at J&L. Here a skilled metallographer examines steel structure through a modern photomicroscope.

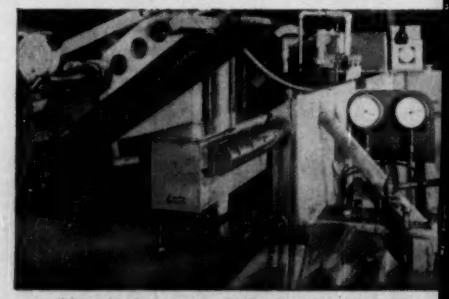
Be 100% Certain...Buy 100% Tested Pressure Tubing

J&L Electricweld pressure tubing is the finest carbon steel tubing available for heat exchanger, condenser, boiler, evaporator and other applications—yet shows savings of as much as 45% against seamless tubing.

J&L Electricweld pressure tubing provides the uniform outside diameter, wall thickness and concentricity that guarantee excellent heat transfer characteristics and fine surface quality. Its strength and ductility assure easy fabrication and installation.

J&L Electricweld pressure tubing is subjected to precise checks at every stage of production, from the basic steelmaking process until the tube is ready for shipment. This series of critical examinations on every length of tubing—inside and out—assure you of perfect field performance. Further details of Electricweld tubing and the economies it offers compared with seamless are available on request from J&L—creator and producer of *unmatched* Electricweld tubing.

J&L uses this latest type of electro-magnetic nondestructive tester to inspect both the inside and outside of Electricweld pressure tubing.



Dimensional accuracy of J&L Electricweld pressure tubing is determined long before fabrication. Shown here is an X-ray gauge control device which continuously measures the gauge of the sheet and strip steel.

This Steelmark identifies products made of steel. Place this mark on your products. And—look for it when you buy.

Steel

J&L STEEL

Jones & Laughlin Steel Corporation

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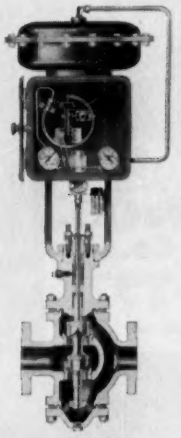
How to get ACCURATE PRESSURE CONTROL IN SPITE OF DEMAND CHANGES

ask your FISHER / MAN about the
WIZARD II
PRESSURE CONTROLLER
with new and improved features
1
VOLUME RELAY for faster response to pressure changes.
2
RESET FEATURE for greater stability and pin-point control, adjustable from .005 to 1 minute per repeat.
3
MEASURING ELEMENT may be brass, steel or stainless steel Bourdon tubes for pressures from 30 to 15,000 psi or Bellows assemblies for pressures below 30 psi and vacuum.

WIZARD I



PRESSURE CONTROLLER

The original Wizard I Pressure Controller is still available for those applications not requiring volume relay or reset features. The simplicity of a self-operated regulator and the accuracy of a pilot or relay operated regulator are found in the Series 4100U. This is, unquestionably, the reason for the continued popularity of the Wizard I series.

As for all Wizards, the Series 4100U is furnished with a universal case which enables the unit to be flush or surface mounted or mounted on yoke of a control valve. Measuring Elements: Bourdon Tube—Bronze, Steel or St. Steel—Ranges 25 to 7,500 psi. Bronze or St. Steel Bellows for vacuum to 25 psi.

The Wizard II has been designed to specifically meet the demands of modern, complex systems requiring closer and faster control. The Wizard II retains the basic simplicity and dependability of the Wizard 4100U, plus more speed and accuracy.

The new design consists of two sub-assemblies encased in a weather proof die cast aluminum housing which is provided with a ¼" pipe threaded vent. Either sub-assembly can be removed without disturbing case mounting. The simple but effective proportional band adjustment (2 to 100%) and the reset adjustment (.005 to 1 min/repeat) along with ease of reversing the action of the Wizard II, have contributed much to its popularity in process control work. All Wizard II controllers, with exception of differential models, can be supplied with a process or controlled pressure gauge installed inside the case.

Careful and exhaustive tests and years of field use have conclusively proved that the Wizard II measures up to rigid Fisher standards.

A COMPLETELY DESCRIPTIVE AND ILLUSTRATED BULLETIN ON THE WIZARD II IS YOURS FOR THE ASKING. WRITE FOR BULLETIN No. D-4150B OR BULLETIN D4100 ON WIZARD I.

IF IT FLOWS THROUGH PIPE ANYWHERE IN THE WORLD...CHANCES ARE IT'S CONTROLLED BY...

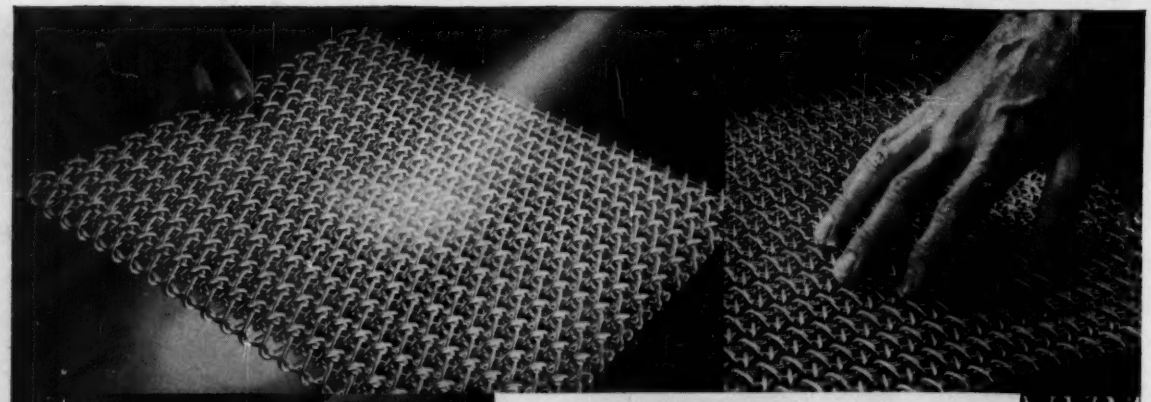
FISHER GOVERNOR COMPANY

Marshalltown, Iowa / Woodstock, Ontario / Rochester, England

BUTTERFLY VALVE DIVISION: CONTINENTAL EQUIP. CO., CORAOPOLIS, PA.

FISHER®

SINCE 1880



These characteristics of

CAMBRIDGE METAL-MESH BELTS

give you fast, low-cost, uniform chemical processing

Whatever you process or package — slab, sheet, pelletized or powdered materials — Cambridge Metal-Mesh Belts combine movement with processing to give you greater production and consistently high quality without costly manual handling.

Open mesh construction allows heat, cold or liquids to flow through the belt and around the product for fast, thorough processing. Liquids drain off quickly, completely. Superior belt design and manufacturing techniques mean longer belt life, fewer repairs, lower operating costs. Smooth belt surface has no sharp edges; can be easily cleaned. Belts can be made heatproof, coldproof, acid proof — in any mesh, weave, metal or alloy — with any side or surface attachments.

Call your Cambridge Field Engineer now. He'll be glad to discuss any aspect of Cambridge Belts — from manufacture to installation and service. Look in the yellow pages under "Belting, Mechanical". Or, write for FREE 130-PAGE REFERENCE MANUAL.

The Cambridge Wire Cloth Co.

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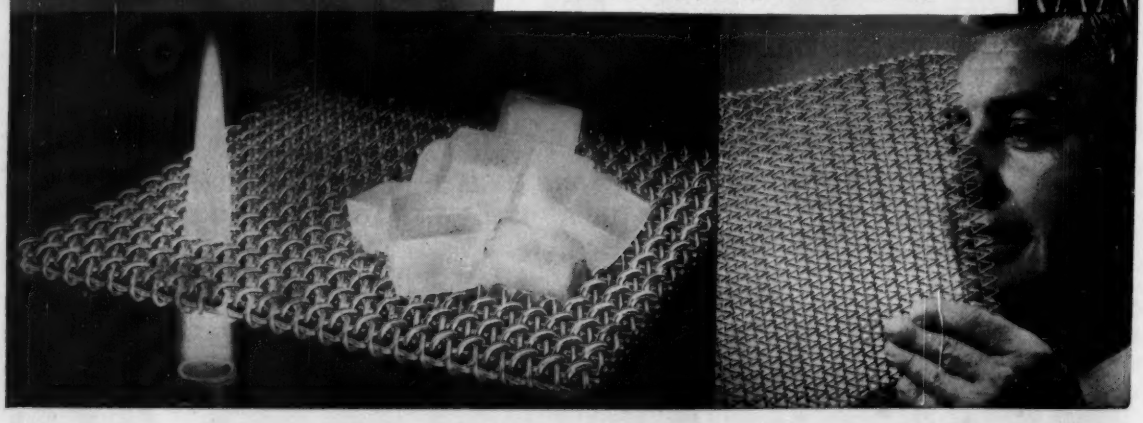
Manufacturers of Wire Cloth, Metal-Mesh Conveyor Belts, Wire Cloth Fabrications



Cooling towers destroyed by fire replaced in twenty-one days

July 12, 1960—Fire destroyed two cooling towers on an 80 ft. high roof at the E. F. Drew & Co., Inc., plant, Boonton, N.J. With production loss estimated at $20,000 per day, speedy replacement was imperative.

July 15—Two new towers were ordered from Foster Wheeler.

July 18—Replacement towers were shipped from FW's *California* plant—three days after receipt of the order . . . six days after the fire.

July 26—Field erection of the towers began.

August 5—Both cooling towers were completed four days ahead of schedule . . . a schedule which represented the best estimated completion time submitted by any manufacturer when the job was bid.

How? Fine teamwork on the part of Drew Co. and Foster Wheeler, plus the availability of FW's pre-engineered towers, pre-fabricated assemblies, and experienced field erection made this performance possible. And quality did not suffer because of speed! These towers were *un-hurriedly* engineered, carefully pre-cut, and fully air-dried long before receipt of the order.

In every Foster Wheeler cooling tower, the dimensions and quality of the redwood, coupled with proper wood-preserving treatment, are your safeguard against delignification and chemical or biological attack. A full range of sizes and casing materials are offered. Write to Foster Wheeler Corporation, 666 Fifth Avenue, N.Y. 19, N.Y.

FOSTER WHEELER

NEW YORK LONDON PARIS ST. CATHARINES, ONT.

A Partlow Model MFS indicating controller is shown in action in this "multiple exposure" shot of a Hole-Core Automatic Molding Machine manufactured by Spo, Inc., Cleveland, Ohio.

The Temperature Control Built to
SHRUG OFF SHOCK
2438 Times a Day

Every working day, the Partlow Temperature Control in this photo takes between 2400 and 2500 solid "roundhouse punches" from the shell-molding machine to which it is attached.

But despite jarring shock and vibration, and a constant barrage of foundry dust, the Partlow goes right on delivering precision control—without letup or breakdown.

Actually, only a control as simple and rock-solid as the Partlow could withstand this kind of punishment! Because only the Partlow contains no hairsprings, or delicate gadgets.

All Partlow thermal elements of the same range are interchangeable *on the job*, too. There's no time lost waiting for your control to come back from the factory. And you get this extra margin of dependability *without loss of accuracy*. Partlow controls are precise to within 1% of scale in any one of 10 ranges from −30° to 1100° F.

If you use or manufacture equipment within this temperature range, there's a Partlow to fit your application exactly . . . and save you money, too. Available in Pneumatic, Electric or Self-Contained Gas types, in recording, indicating or non-indicating models! To field test any Partlow control . . . or to obtain full details write, The Partlow Corporation, New Hartford, N. Y. Dept. E-960.

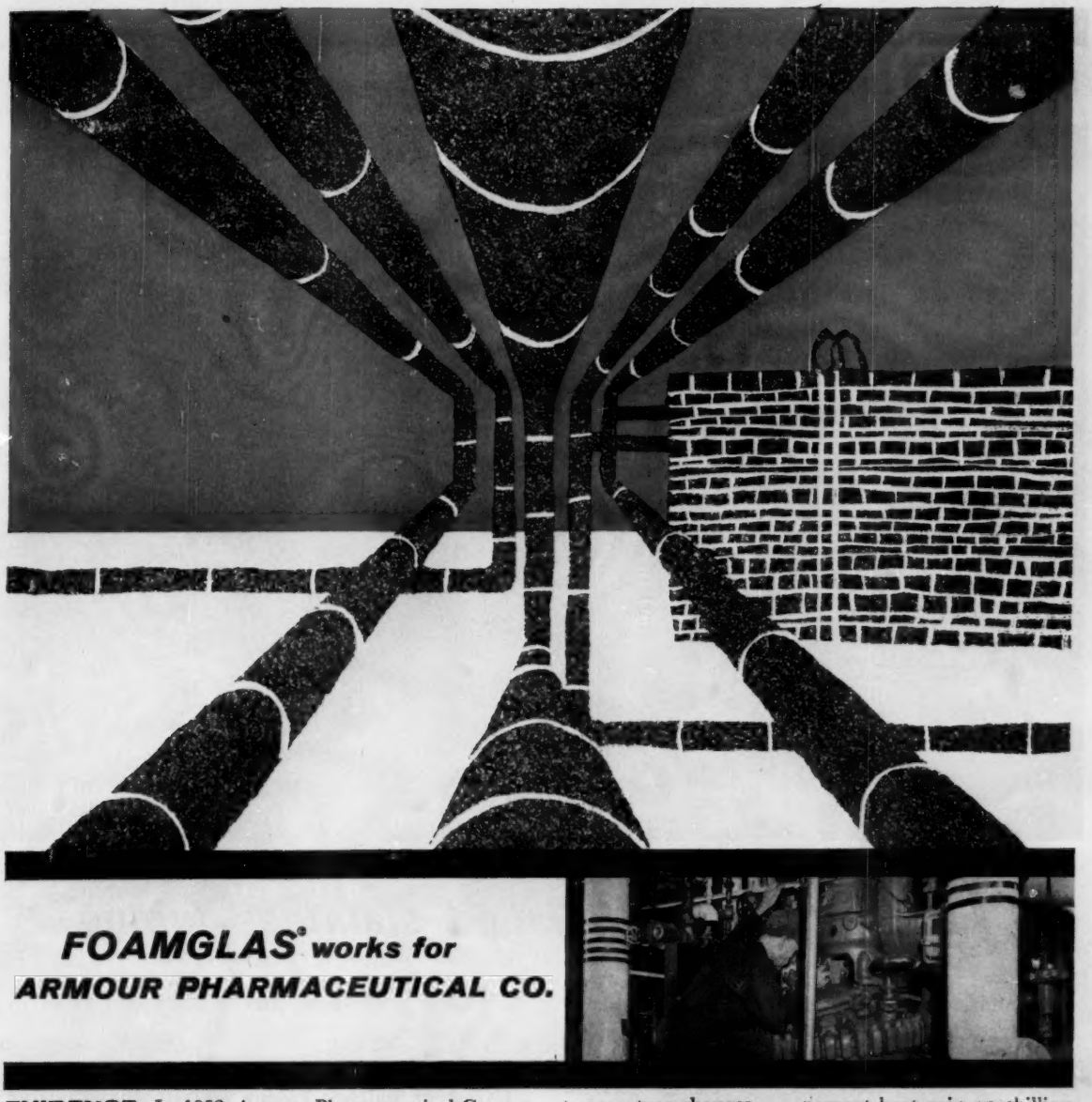
Export: Ad. Auriema, Inc., 85 Broad St., New York 4, N. Y.

A complete absence of gadgets and superfluous parts, as seen in this open view of the new MFS indicating control, explains the Partlow's unique ability to function accurately even under the most severe operating conditions.

You can pay more but you can't buy better than

PARTLOW

TEMPERATURE CONTROLS



FOAMGLAS® works for ARMOUR PHARMACEUTICAL CO.

EVIDENCE: In 1953, Armour Pharmaceutical Company, a division of Armour and Company, constructed a modern pharmaceutical lab at Kankakee, Ill. Insulation needs were varied and demanding. Armour found one material—FOAMGLAS insulation—that worked in a variety of applications: in special cold rooms, in piping, tanks and vessels. The reason? This unique combination of benefits: constant insulating value; high compressive strength; incombustibility; vapor-proof; and ease of cutting and shaping.

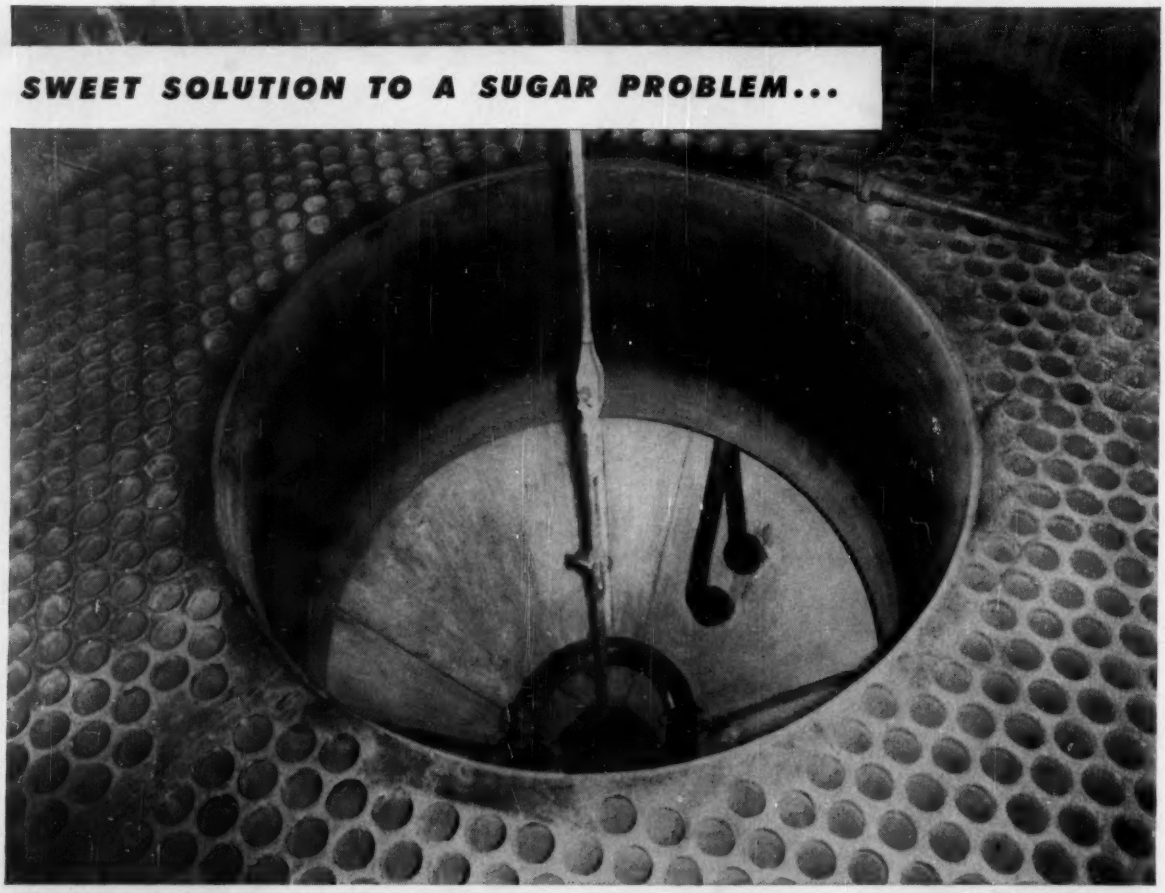
Outdoors, FOAMGLAS insulation works to: protect ammonia lines against condensation, corrosion, and harsh temperature changes . . . prevent heat gain on chilling tanks and piping. Indoors, FOAMGLAS insulation forms a complete envelope—floors, walls and ceilings—in cold storage rooms where various temperatures from —20° on up must be maintained . . . holds chilled water piping at a constant 42°. And all this without maintenance problems.

See how FOAMGLAS can work on your insulation problems. Write for a free copy of our Insulation Catalog and the Armour Fact Sheet. Pittsburgh Corning Corp., Dept. H-90A, One Gateway Center, Pittsburgh 22, Pennsylvania. In Canada: 3333 Cavendish Boulevard, Montreal, Quebec.

Pittsburgh Corning makes available a complete line of accessory materials for use with FOAMGLAS insulation. Write for Data Sheets.

PITTSBURGH PC CORNING

SWEET SOLUTION TO A SUGAR PROBLEM...



Carpenter full-finished stainless tubing

• Calandria heating units, used in processing sugar, must resist both abrasion and corrosion. Externally, the tubing is attacked by ammonia and other steam-generated gases. Internally, the tubing gets an abrasive buffeting from crystal-bearing sugar syrup. Copper-Nickel Alloy tubing failed prematurely under this double attack.

The economical solution was Carpenter Type 304 Stainless Full-Finished Tubing. The result: Less equipment downtime, lower maintenance costs, increased production, and over-all economies in operation.

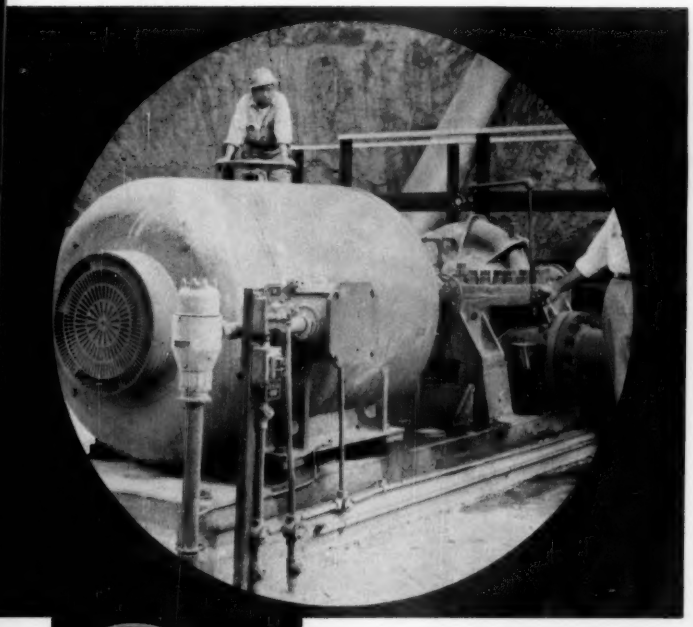
The consistent quality and greater uniformity of Carpenter Stainless Tubing were influential factors in its selection. Carpenter delivers these advantages plus the biggest extra of all . . . new, lower initial cost. For prompt service or delivery from mill stocks, call your Carpenter representative or write: The Carpenter Steel Company, Alloy Tube Division, Union, N. J.

your master key to cost-saving corrosion control

Stainless Tubing & Pipe

Take the "trouble" out of tough jobs... use WAGNER® BIG JOB-RATED MOTORS

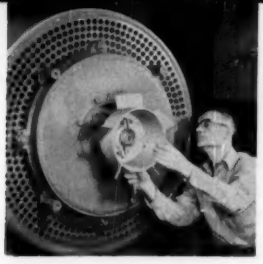
Wagner® Big Job-Rated Motors are all muscle. Power-packed, and with plenty of stamina, they're perfect drives for big pumps, fans, blowers, compressors... any heavy-duty application. When you need big motors that can operate for long periods of time without maintenance... that keep right on producing the power you need even under the most critical operating conditions... choose from Wagner Types RP, YP & ZP Motors. Put into service, they'll solve your large motor problems.



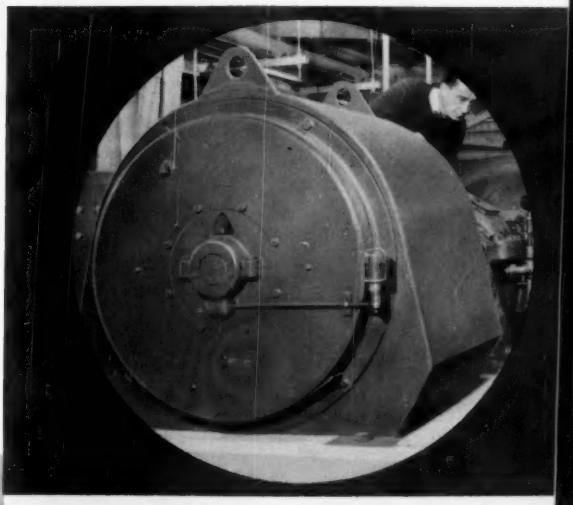
Built in ratings through 500 horsepower, totally-enclosed, fan-cooled YP and ZP Motors are tube ventilated for cooler running, long life. Type YP, standard TEFC, is available with Class A or Class B insulation; Type ZP, explosion-proof, with Class A insulation only. Type ZP can be supplied with Underwriters' Label for Class I, Group C or D, or for Class II, Group E, F, or G locations.

Compact, dripproof RP Motors can be used in many applications that used to require splashproof motors. Their newly designed enclosures resist external damage from corrosion or rough treatment, and prevent penetration of liquids. Windings stay dry, always. Available in ratings from 250 through 1,000 horsepower, Wagner RP Motors meet or exceed NEMA standards for polyphase squirrel-cage induction motors over 200 hp.

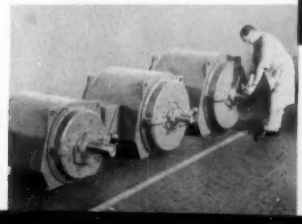
For complete information on economical, efficient Big Job-Rated Motors, contact the Wagner branch nearest you, or write for Bulletins MU-230 and MU-232.



Wagner Types YP & ZP Motors have fabricated steel frames that contain a series of tubes through which cooling air is forced by an external blower. Internal blowers, one at each end of the rotor, circulate the warm air inside the motor through ducts in the rotor and stator and around cooling tubes.



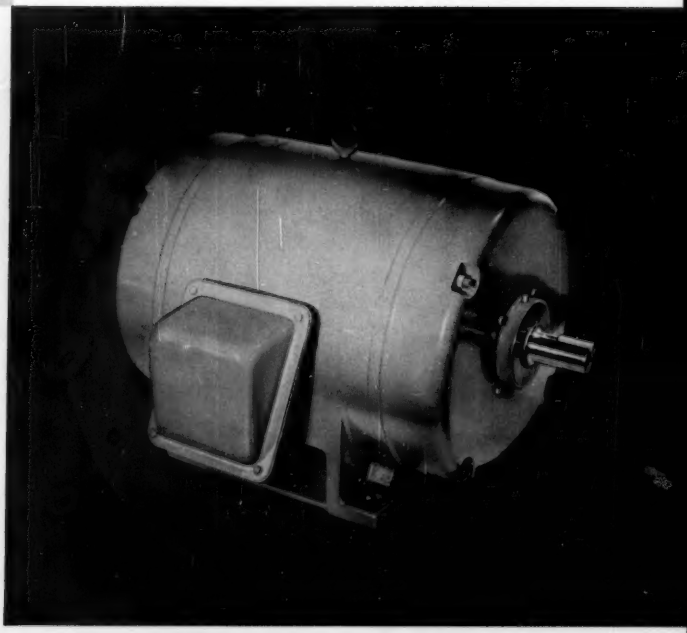
Wagner Type RP Motors have electrical stamina that matches their mechanical ruggedness. They are available in frame sizes 504US through 962S.



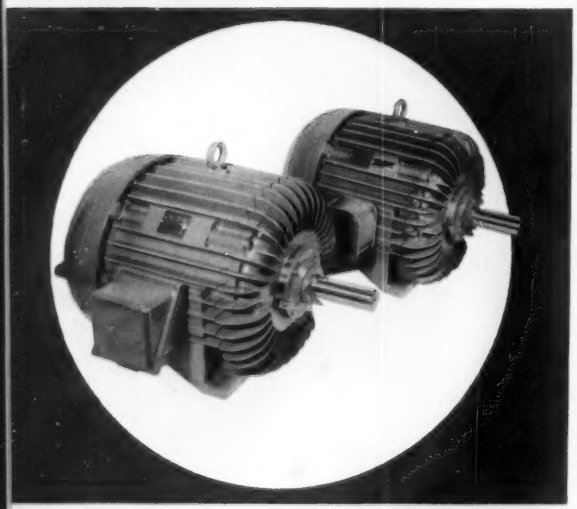
Wagner Electric Corporation
6400 PLYMOUTH AVENUE, ST. LOUIS 33, MISSOURI

Ease the profit squeeze... cut expensive downtime with WAGNER® PROTECTED-TYPE MOTORS

Wagner DP Motors can't be affected by moisture, corrosive acids, salts, and alkalies. Air intakes and outlets are positioned to provide complete dripproof protection.



Wagner EP & JP Motors are completely protected against dust, abrasives, fumes, steel chips, or filings. Both ends of these motors have running shaft seals to keep the heavy-duty bearings clean.



Wagner® Protected-Type Motors do cut expensive downtime. Keep production rates up, too. For they operate with complete dependability... provide continuous service under the most severe conditions in their specific applications. To top it all, they pack plenty of power into precious little space, are lightweight and long-lived. Simply put... they get the job done.

Wagner Types DP, EP & JP Motors can bring you savings in initial costs, maintenance costs, and in continuity of operation. All three types are built with rugged, corrosion-resistant cast iron frames in NEMA size 182 through 445U. All are designed to meet a wide variety of applications. DP Motors, with their dripproof enclosures, can be used in many spots that once required splashproof motors. Totally-enclosed, fan-cooled EP and JP Motors (Type JP is also explosion-proof) are perfect power packages for automated lines. For complete information on these motors contact the Wagner branch nearest you, or write for Bulletins MU-223 and MU-224.

Wagner Electric Corporation
6400 PLYMOUTH AVENUE, ST. LOUIS 33, MISSOURI

WM60-21

Chementator

New electrode concept boosts fuel-cell power fourfold

Joining the growing ranks of fuel-cell researchers with the flat statement that "our work has shown that established views on fuel-cell electrode operation are incorrect," Shell Petroleum (England) has built a fuel cell with a "radically different" electrode. The low-temperature hydrogen-oxygen cell develops 3-5 kw./cu. ft., about four times the present output of low-temperature cells.

Shell will give out no details of its new electrode design but provides these operating data: at room temperature, cell achieves current density of 70 amp./sq. ft.; raising operating temperature to 60 C. doubles current density; cell uses acid or alkaline electrolytes, operates at 3 psig. on air or oxygen.

A 20-cell unit has been built with individual cells only 0.167-in. thick. Shell believes power-to-weight ratios of up to 50 w./lb. are possible with its new electrode. Best ratio to date for a low-temperature cell: about 10 w./lb.

Cuba provides technical gold mine for Russian engineer-prospectors

News filtering out of Cuba indicates that Russian technicians who are running the three expropriated oil refineries are harvesting a technological windfall. According to press reports, the Soviet engineers are closely studying operating data and design of the refining units. This could affect U. S. export policy, which until now has banned sale of refining technology to communist countries.

The expropriated Texaco and Esso refineries are quite modern and, judging from recent reports on Soviet oil refineries, contain techniques not yet in use in Russia. Esso's plant, for example, has a two-stage atmospheric pipe still, Model 4 catalytic cracker, Powerformer, hydrofiner and a non-selective polymerization unit.

Besides the three companies whose refineries are involved, Universal Oil Products also has a large stake in these developments. Reason: there is a UOP Platformer in the Shell refinery and a Platformer-Unifiner at the Texaco facility. UOP, which has been barred from selling its processes to Iron Curtain countries, declares it is "disturbing" to find the Russians getting this know-how for nothing.

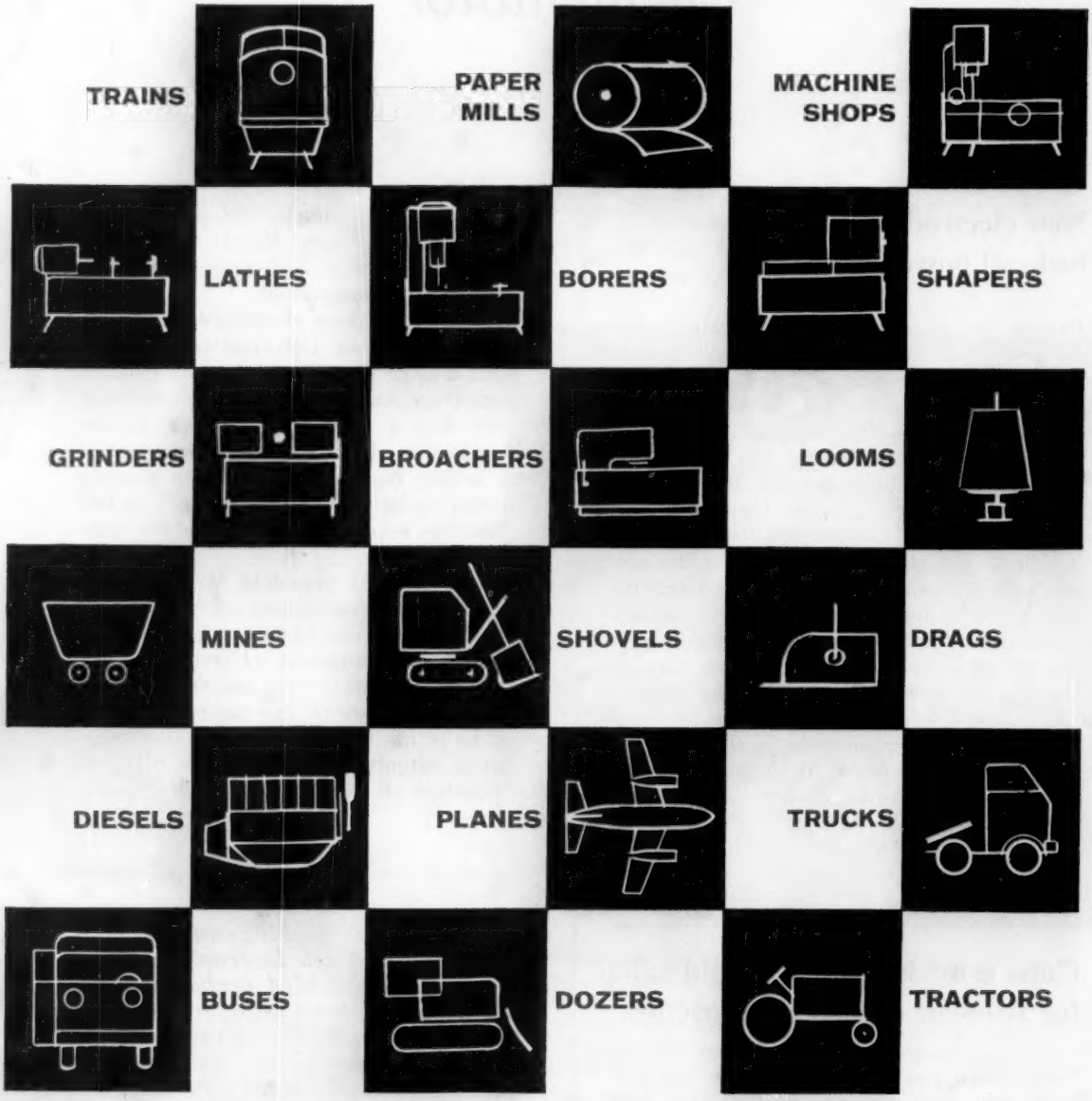
However, UOP president M. P. Venema says that recent developments are not sufficient reason to change our basic export policy because UOP has improved its processes since the Cuban units were built and the Russians do not have access to this information. Besides, he points out, much of the UOP technology is patented and has been available to the Russians all along from the U. S. patent office.

Du Pont is now making commercial quantities of black Dacron by mixing in finely divided carbon black via a special process before extrusion. The new fibers can create new patterns when woven with other fibers because the black threads will not accept conventional dyes.

Urethane-foam panels gain entry into building-industry markets

Bidding to replace foamed styrene before it ever gets established, several firms are actively promoting urethane-foam-backed curtain wall

If you manage or operate any of these...



...your best move is to Sinclair's specialized greases, oils and lubricants, to cut costs, speed operations and increase profits. There are more than 500 of these money-savers, and each does its particular job particularly well. For helpful information based on actual experience, call your Sinclair Representative or write

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panels. Two companies—Casavan Industries, Paterson, N.J., and American Bridge Div. of U. S. Steel—are known to have already supplied urethane panels for about a dozen buildings.

Many industry observers now believe that rigid urethane foam stands a better chance than styrene foam to achieve the goal of getting the plastics producer solidly established in the building trade. They point to urethane foam's higher insulating capacity, higher strength and ease of processing. Raw-material costs for styrene foam are now lower than urethane, but this could change in the near future.

Casavan, a major supplier of marble and vitreous ceramics, cites several advantages for urethane in mosaic curtain walls. Ordinarily, mosaic panels are backed with about 4 in. of concrete. Backing with an equivalent thickness of urethane foam not only reduces weight dramatically but also lowers cost as much as 30%. Too, the lighter panels cost less to install, and allow considerable savings on structural steel in large buildings.

R. L. Strickman, Casavan's director of research, also says he has developed a rigid urethane foam with a compressive strength of about 125 psi. at a density of 2-2.5 lb./cu. ft., around four times the strength of ordinary rigid foams. This opens up the possibility of using urethane foam panels as load-bearing elements.

American Bridge says that more than half a dozen buildings with foam-backed steel panels have been erected and that it has been pleasantly surprised by the conservative building trade's acceptance of urethane. The company says, in addition, it prefers urethane over styrene foam because it adheres directly to the steel panels without use of adhesives.

New process expands role of TVA ammoniator in fertilizer making

Fertilizer producers who have a TVA ammoniator in their plants can now, with minor modifications, start making diammonium phosphate. This is the conclusion of researchers at Tennessee Valley Authority's Wilson Dam, Ala., installation, resulting from work in a 1-ton/hr. pilot plant.

The new process, built around the TVA ammoniator, can use low-cost wet-process phosphoric acid. Or when furnace acid is used, fertilizer with N-P-K analysis as high as 21-53-0 can be produced. Diammonium phosphate, which is rapidly gaining in popularity because of its high ammonia content, is currently made by a variety of processes. One route ammoniates phosphoric-acid sludge batchwise, then dries and granulates it.

In the TVA process, phosphoric acid is partially preneutralized with ammonia in a tank, followed by completion of ammoniation in the ammoniator-granulator drum. Heat of reaction supplies much of the heat needed for drying. Excess ammonia in the exhaust gases is scrubbed out with phosphoric acid, which is then fed to the neutralizing tank.

Recycle ratio of about 3:1 is required for control of granulation (some processes now in use require recycle rates as high as 20:1). Physical properties of the closely sized granular product are claimed to be excellent.

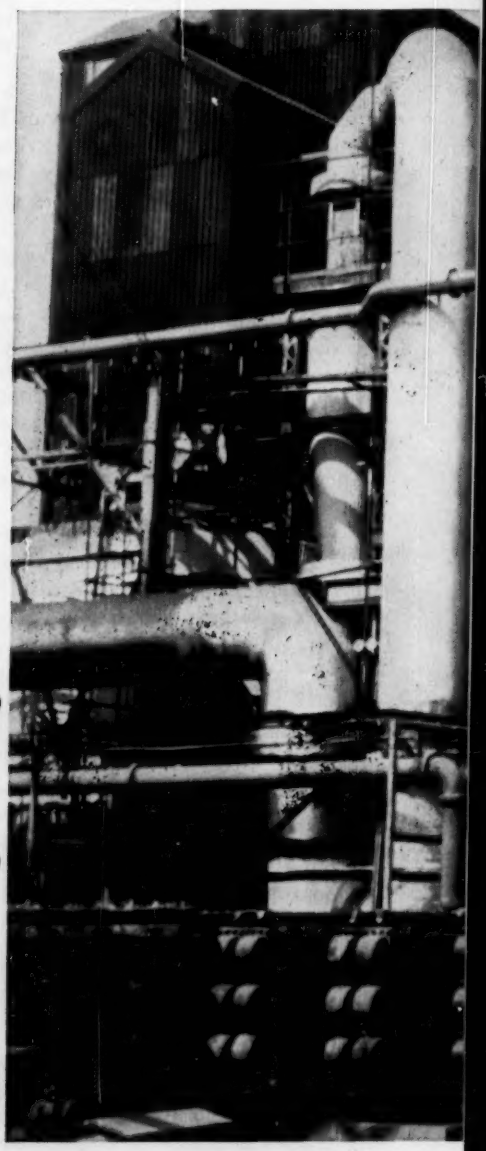
City council of Baytown, Tex., has voted to annex just enough of Humble Oil's nearby refinery to balance the city's budget. Baytown's $1,351,159 budget is $322,700 short. Humble indicates it will pay the taxes on the annexed portion of its refinery without protest.

Sohio reveals first details of its new acrylonitrile process

This week, engineers at the Tulsa, Okla., meeting of the American Institute of Chemical Engineers are hearing the initial description of Standard Oil of Ohio's process for making acrylonitrile from propylene and ammonia. This route, which has stirred wide industry interest because of its use of cheap raw materials, has been commercialized in Sohio's new 40-million-lb./yr. plant at Lima, Ohio.

Heart of the flowsheet is a fluid-bed reactor that contacts ordinary refinery propylene with fertilizer-grade ammonia over an unidentified Sohio-developed catalyst. Reactor

(Continued on page 88)



first ***ferrous sulfate decomposition*** *plant in the United Kingdom uses...*

DORRCO® FLUOSOLIDS® SYSTEM

For precise, controlled roasting...

Once again, the versatility of the Dorrco FluoSolids System for roasting has been demonstrated at the new ferrous sulfate plant of British Titan Products Company, Ltd., Grimsby, England . . . the first plant of its kind in the U. K.

The prime contractor was Chemico; equipment and engineering for the roasting step were handled by Dorr-Oliver Company Ltd., Croydon, Surrey.

Copperas arises as a by-product in the extraction of titanium dioxide from ilmenite. In a process developed by British Titan, the copperas is converted to a dry monohydrate powder, by spray drying.

Mixed with pulverized coal or pyrites, the monohydrate is then injected into a fluid bed where it is decomposed to SO_2 gas and iron oxides.

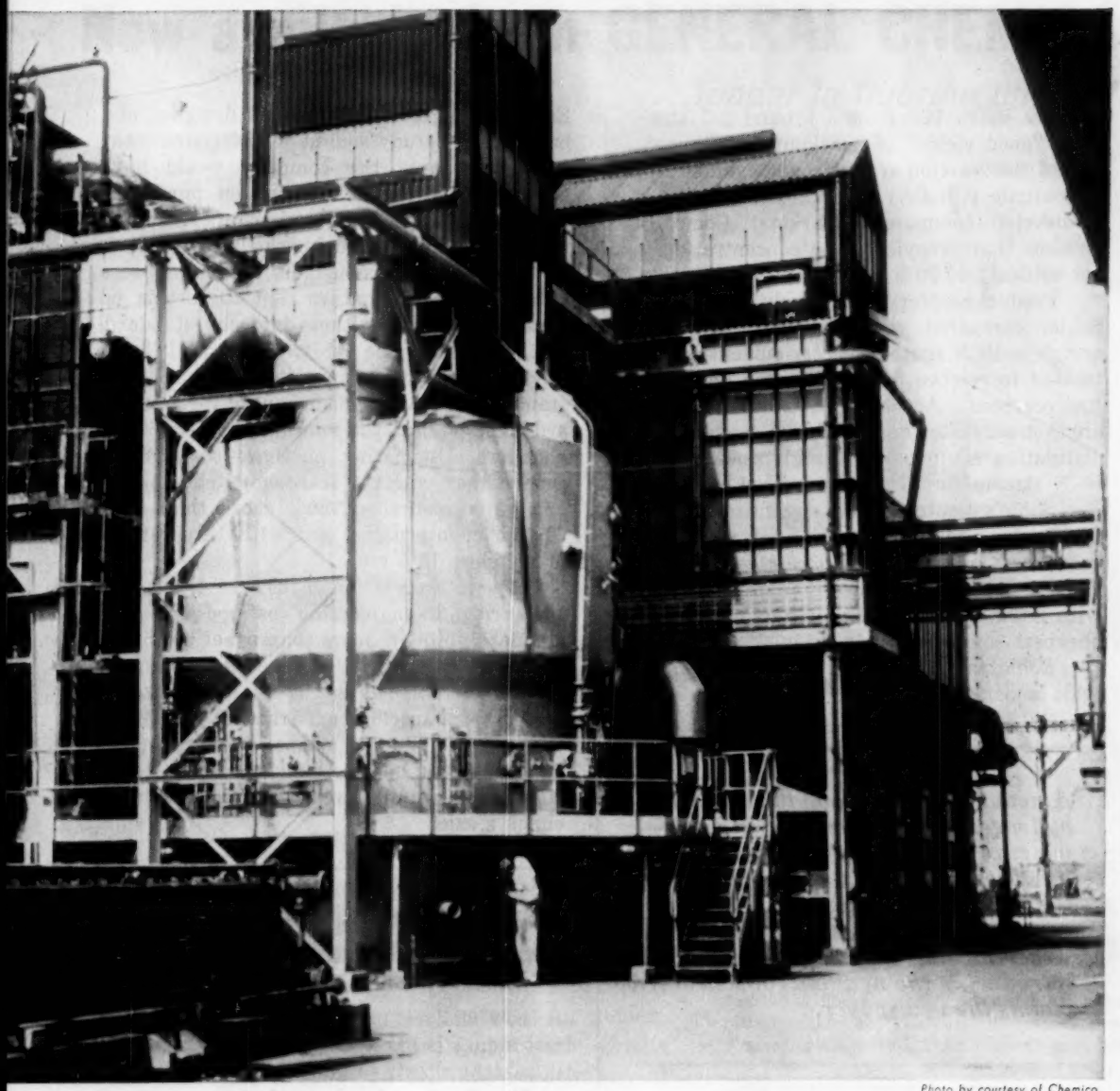


Photo by courtesy of Chemico.

The gases, on leaving the FluoSolids reactors, pass through a waste heat boiler and then on to a Chemico purification and contact acid plant to produce up to 60 tons of acid per reactor, daily. The calcine, relatively pure iron oxide, averaging 1.25% residual sulphur, can be readily sintered for use in steel making.

An alternative process, especially applicable to the treatment of steel plate pickling liquors, decomposes a wet monohydrate cake, obtained from a submerged combustion system, by first drying the cake with waste heat gases. The system offers a larger yield in acid recovery, and lower fuel costs.

For further information on the Dorrco FluoSolids System, please write to Dorr-Oliver Incorporated, Stamford, Connecticut.

What is the FluoSolids System?

A valuable tool for the process industries. When particles are suspended in an upwardly moving stream of gas, the entire dense mass behaves much like a liquid and is said to be fluidized. Applied in the Dorrco fluid bed reactor, fluidization results in a new and more efficient roasting technique, in which each particle of material is individually surrounded by a film of air or gas supplied by an external blower. A combination of reactor, blower, cyclones and other auxiliary equipment forms a complete processing system adaptable to a wide range of applications.

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operates below 930 F. and around 2-3 atm., gives "good yields" of acrylonitrile. Byproducts of the reaction are hydrogen cyanide and acetonitrile (CH_3CN), for which Sohio hopes to develop commercial markets. Company stresses that propylene feed concentration is not critical; 40-90% propylene is acceptable.

Product recovery is relatively simple, says Sohio, compared with the currently used acetylene-HCN route. Reactor effluent is first treated to remove fixed gases and unreacted hydrocarbons. Acrylonitrile and acetonitrile are then separated and purified in conventional distillation equipment. A high-concentration HCN stream can also be recovered.

Sohio's route differs significantly from Du Pont's previously announced propylene-based acrylo process (*Chementator*, Nov. 16, 1959, p. 89). In that process, propylene reacts with nitric oxide; ammonia enters only as the cheapest source of nitric oxide.

Sohio says it is negotiating on a worldwide basis for licensing of its process.

A new kind of microbe that absorbs hydrogen from either water or petroleum streams has been developed by Russian scientists, according to the Soviet newspaper,* Trud. *Hydrogen content of gas stream from an experimental well was halved by introducing the new microbe strain, claims the newspaper.

Esso finds standard exchangers can't compete with custom units

Backers of process equipment standardization —and especially of heat exchanger standardization—suffered a major blow last month at the National Heat Transfer Conference in Buffalo, N.Y. At the meeting, cosponsored by AIChE and ASME, Carl Segel of Esso Research and Engineering declared that standard heat exchangers are 15-20% *more* costly than custom-built units.

Basis for this view: a recently completed comparative cost study of 141 new and replacement exchangers recently purchased and installed by Esso. These units—as are all Esso exchangers—were custom designed and built. Esso's study sought to determine what savings, if any, the company would have gained had the exchangers been purchased on the basis of heat exchanger standards that Esso worked up during the last two years.

Many of the exchangers, of course, were of such a special nature that there was no possibility of fitting them into any standard. But, by using one of two standard baffle pitches, about 40 of the units could have been standardized. And by using one of three standard baffle pitches, the total increased to 60 exchangers. Estimating purchase costs, Segel reports that, with two standard pitches, standard units cost about 20% more than their custom counterparts; and with three standard pitches, 15% more.

One interpretation of these results is that the savings in engineering costs possible with standard units are more than offset by higher material costs because standard exchangers most likely will not be the minimum size required for a specific heat transfer job. Moreover, in the fiercely competitive exchanger-manufacturing business, engineering costs for custom-built units are often thrown in to clinch a sale.

New dialysis-membrane process can make saltiest of seas drinkable

A new dialysis-membrane process unveiled last month is likely to play an important role in current efforts to find economical means of making fresh water from the sea.

Developed by Sidney Loeb and Srinivasa Sourirajan of the U. of Calif. (Los Angeles), the process is said to be able to desalt water of salinities over 50,000 ppm.—considerably higher than the saltiest of seas. Until now, membrane routes such as dialysis and electrodialysis (*Chem. Eng.*, July 25, p. 105) have been regarded as attractive only for treating inland brackish waters of not much higher salt concentrations than 15,000 ppm. Moreover, the UCLA route is claimed to make water desalting some 100 times faster than previous membrane processes.

Loeb and Sourirajan have demonstrated their process on a lab scale. And though they refrain from making any cost estimates before operating on a larger scale, the two engi-

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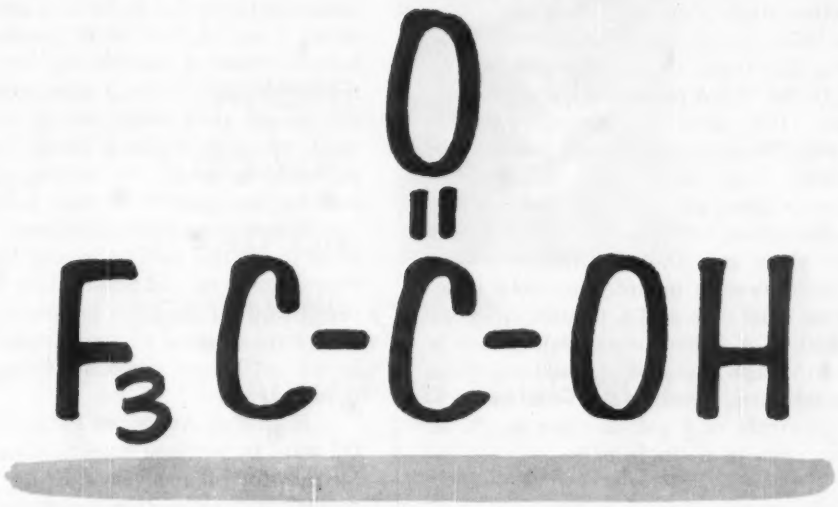

TRIFLUOROACETIC ACID

General Chemical now offers another functional fluoro-organic compound – *Trifluoroacetic Acid* – in developmental quantities. This non-oxidizing, strong acid shows unusual properties that suggest great utility in fluoro-organic synthesis and as a versatile catalyst for condensations, esterifications, polymerizations, Friedel-Crafts reactions and the like. If you are interested in any of these reactions, General Chemical's Trifluoroacetic Acid should be included in your investigations.

Trifluoroacetic Acid is an addition to General's present group of highly reactive, functional fluoro-organics – *Dichlorotetrafluoroacetone*, *Trichlorotrifluoroacetone* and *Monochlorodifluoroacetic Acid*.

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neers are convinced that their findings deserve further study. Currently, they are working on a 500-gal./day unit that is to provide data for a 25,000-gal./day pilot plant.

Key to the UCLA process is a new dialysis membrane. It's made by mixing cellulose acetate with aqueous magnesium perchlorate and acetone, then casting the cold sticky mixture on a glass plate. After a cold water wash, a film about 0.004 in. thick is stripped from the glass and shrunk slightly in hot water. Membrane is mounted on both sides of a porous steel disk and a number of disks are stacked in a frame press. Salt water is circulated through this unit at 1,500 psi. With these membranes, fresh water can be produced at the rate of 8 gal./day per sq. ft. of membrane area in a single pass.

Commercial production of two graft-polymer fibers are under serious study in Japan. Toyo Spinning will start pilot-plant production of acrylonitrile-grafted viscose staple early next year. And Dai Nippon is working on plans for a commercial-scale plant to make vinyl alcohol-grafted cotton.

Some big "ifs" block commercial development of tar sands

Alberta's Oil and Gas Conservation Board has concluded hearings into the commercial future of the province's vast tar-sand deposits. Highlight of the sessions was vigorous opposition by the Cities Service group to Great Canadian Oil Sands' bid for permission to start a commercial tar sands venture (*Chementator*, June 27, p. 55). And although Cities Service admitted it could design an operable commercial plant within a year, it said the economics of such a plant are still doubtful.

During the hearing on Great Canadian's application, Cities Service contended that the firm had not done enough research to warrant a commercial venture, with the possibility that the project's failure might prejudice the case of other companies working in the field. Cities Service says its research has pointed up some critical materials-handling problems, main headache being the disposal of sand tailings—about 1 cu. yd./bbl. of oil produced. If the tailings from a 30,000-bbl./day plant were merely stacked in huge piles, there would be the danger that under certain conditions the sand would flow like a liquid, engulfing the surrounding area. No mining operation has ever had to cope with so much tailings.

The Alberta board also heard applications from the Cities Service group, Pan American Petroleum Corp. and Shell Oil for permission to continue their research programs. The board is now considering all four applications, but it is not yet known when decisions will be rendered.

Both Pan American Petroleum and Shell Oil want to continue investigating *in situ* combustion for oil recovery. Cities Service estimates its extraction pilot-plant research (*Chem. Eng.*, Feb. 22, p. 66) will take two to three years to complete.

Major advances chalked up by two heat-to-electricity devices

Two devices for the direct conversion of heat to electricity scored major advances last month:

• Thermionic converters went into comparatively large-scale commercial production for the first time. General Electric brought on the line, in Schenectady, N.Y., a facility for turning out 1-w. units at the rate of 100/week. Intended initially for space-vehicle power-generating jobs, GE's converters will go on the market next month at prices ranging from $300 to $350 per unit. Until now, thermionic devices have been considered to be only in the earliest development stages (*Chem. Eng.*, April 18, p. 88).

• Nuclear core of the Atomic Energy Commission's SNAP-10 thermoelectric direct-conversion homogeneous reactor (*Chementator*, Dec. 14, 1959, p. 76) went critical. Designed and built by Atomics International, at Canoga Park, Calif., the core measures 7-in. high by 7-in. dia., weighs less than 200 lb., uses a fuel-moderator mixture of uranium-235 and zirconium hydride. Complete SNAP-10 system, to be in operation next year, consists of thermoelectric units surrounding this core, will generate 300 w. of electricity.

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Far-sighted leaders in industry are realizing the benefits made possible by applying computer control systems to their processes.

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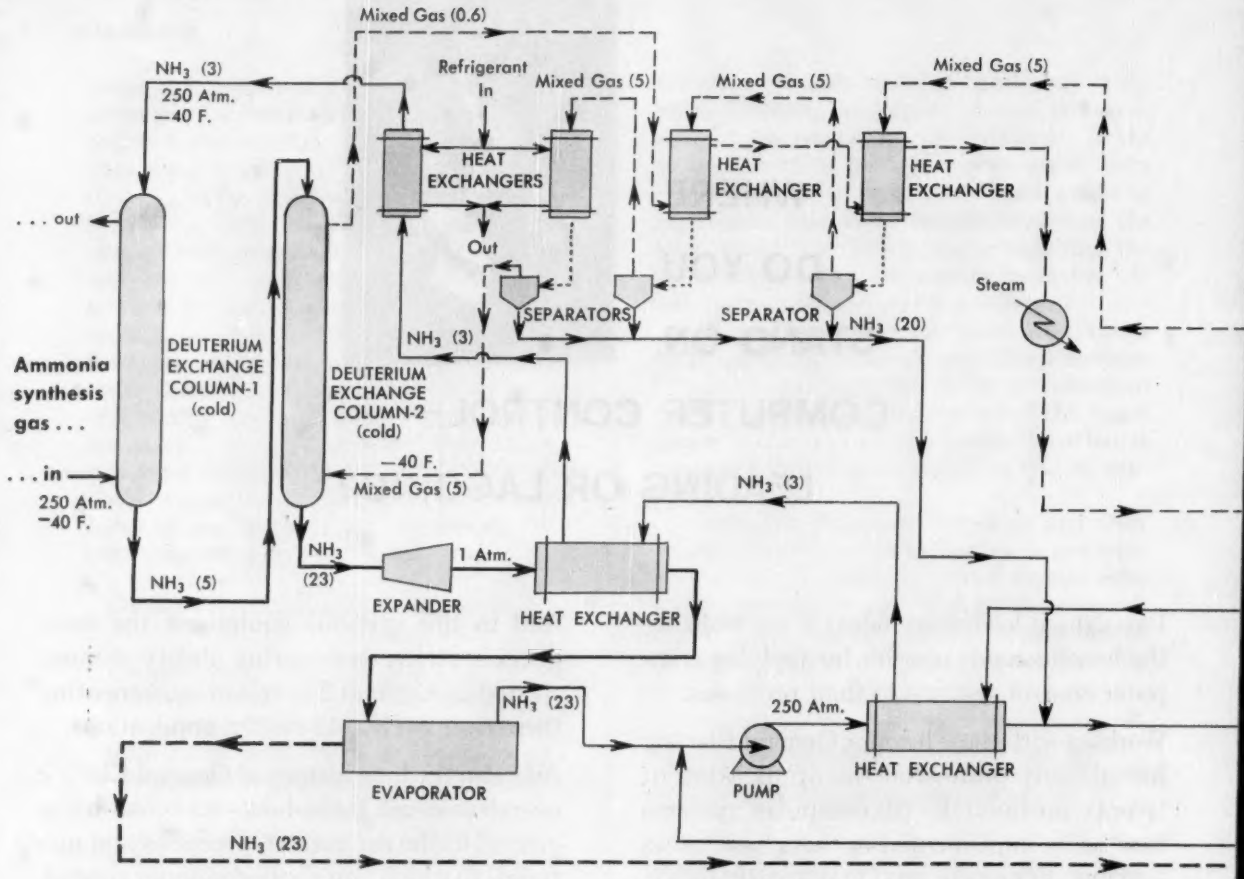


HEAVY WATER STAKES LURE NEW ENTRY

New British process that employs ammonia to transfer deuterium from synthesis gas to demineralized water, is seen shaving production costs.

Seeking to strike off the shackles of dependence on American heavy water, Constructors John Brown, London, hopes its new process will constitute a British declaration of independence.

Indeed, CJB proposes independence for any country whose nuclear activity centers around heavy-water-moderated reactors. Such reactors are typically used in underdeveloped nations that work only with natural or slightly enriched uranium.

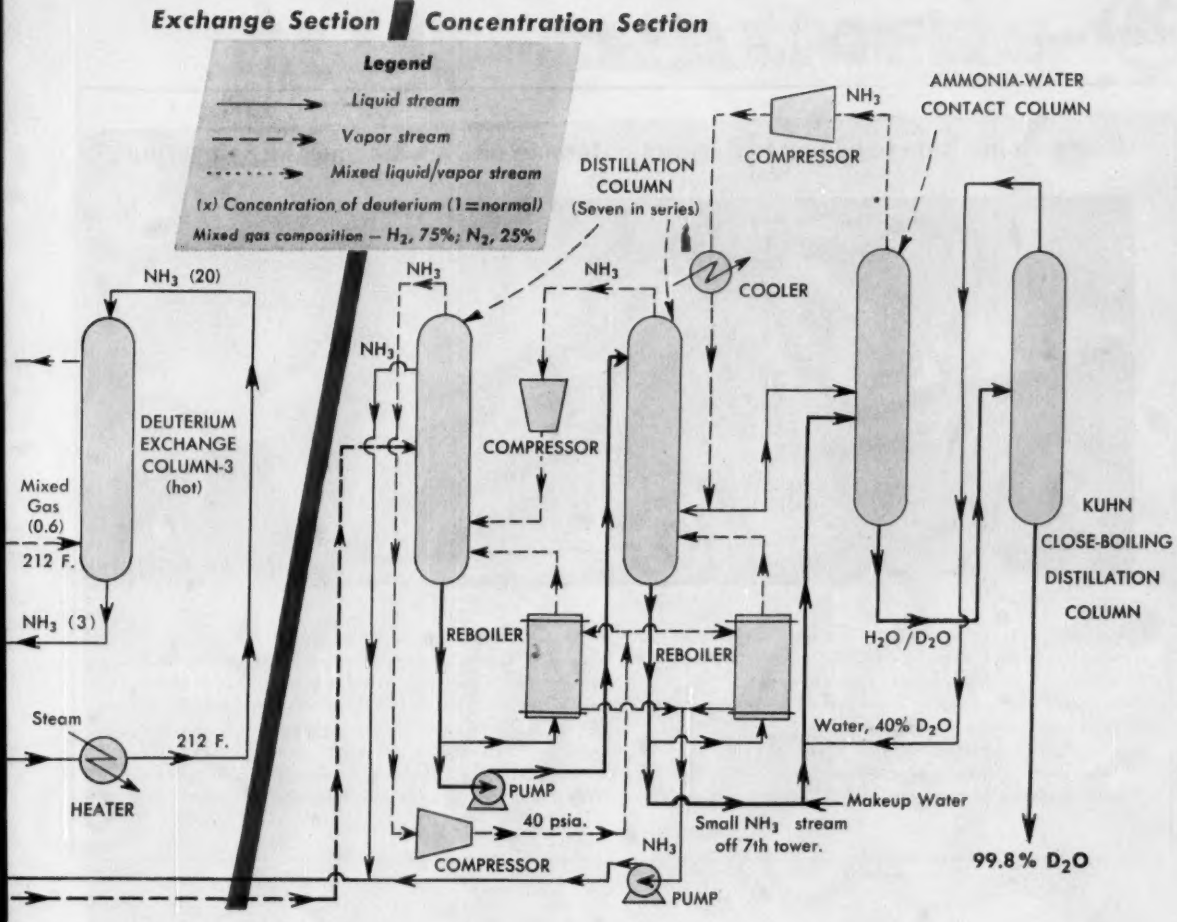
Countries that are also promoting large agricultural programs should be especially interested in the process, says CJB. Paired with a standard ammonia unit, the heavy-water plant would borrow hydrogen gas, extract deuterium from it, return hydrogen to be used for ammonia synthesis.

► **Cost of Plant**—Although its proposed plant is only 1/15 as large as AEC's sprawling Savannah River complex, CJB expects it to make D_2O for a little less. Anticipated cost of $21.50/lb. includes operating costs and 15% capital charges. AEC selling price for deuterium extracted from ordinary water is $28/lb.

Future production costs might be shaved if demand for the isotope N^{15} develops as expected. The process yields, as a byproduct, ammonia enriched threefold in N^{15}.

Preliminary engineering design has been completed for a plant to make some 31 tons/yr. of heavy water, at a total capital investment of just under $6 million. CJB claims that the design includes only standard equipment that requires no special corrosion protection.

► **Process in Brief**—The process is



based on the principle that deuterium atoms will transfer from H_2 to ammonia at subzero temperatures, but at 212 F. will leave the ammonia molecule in preference for hydrogen.

In operation deuterium is extracted catalytically from ammonia synthesis gas (75% H_2, 25% N_2) at −40 F. by liquid ammonia. The ammonia is further enriched by contact with a deuterium-loaded recycle gas stream in second cold tower. Half of the rich ammonia is vaporized and sent to a series of distillation columns that concentrate the deuterium to 75%. The deuterium exchanges with hydrogen in demineralized water. A high-efficiency Kuhn column separates H_2O from D_2O to give 99.8% pure D_2O.

Unvaporized ammonia, containing all the catalyst, gives up its deuterium to the recycle gas stream at 212 F. Ammonia draining from this tower is then cooled and recycled to contact incoming fresh hydrogen. The rich gas is cooled (liquid ammonia condenses out) then recycled to the second cold tower to enrich ammonia.

▶ **Two-Section Process**—Let's look at the CJB process in detail. It consists of two main sections, one for deuterium exchange, one for concentration. We'll trace the former.

Ammonia synthesis gas (250 atm., −40 F.) is scrubbed with liquid ammonia containing potassium amide catalyst. About 70% of the deuterium in the gas transfers to the ammonia phase.

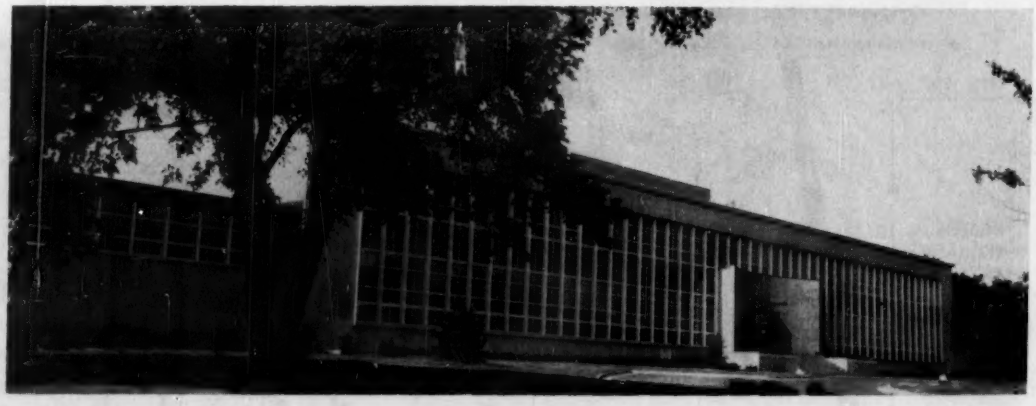
Liquid ammonia from this operation (deuterium concentration five times normal) then contacts a mixed gas stream countercurrently in a second cold tower. (The mixed gas has the same composition as the ammonia synthesis gas, 75% H_2, 25% N_2, but circulates in a closed system.) The gas, giving up deuterium to the liquid, reduces its concentration from 5 to 0.6 times normal. The liquid is enriched to 23 times normal deuterium.

Enriched ammonia from the bottom of the tower, after being expanded to atmospheric pressure and warmed to −3 F., feeds an evaporator where half of the liquid is vaporized and sent to the distillation section, described later.

▶ **Ammonia Now Heated** — Flow from bottom of the evaporator is liquid ammonia containing all of the catalyst. This stream joins a lean ammonia stream coming from the distillation section, is pressured to 250 atm., joined by other ammonia streams described below, and heated to 212 F.

The hot ammonia (deuterium concentration 20 times normal) then countercurrently contacts hot recycle gas and gives up deuterium. Now reduced to three times normal deuterium concentration, ammonia

Research institute to be toured during Conference on New Chemical Engineering



Midwest Research Institute has announced that its Kansas City, Mo., facilities will be opened for touring by attendees of the upcoming Conference on the New Chemical Engineering (Chementator, Aug. 22, p. 52). Conference, jointly sponsored by MRI and Chemical Engineering magazine, is slated for the Muehlebach Hotel in Kansas City on Nov. 29 and 30.

Main building of the Institute, completed in 1955 and expanded last year, contains some 100,000 sq. ft. It houses 86 laboratories with the most advanced research equipment, in addition to pilot plants, model shops and computing centers. A not-for-profit, independent organization, MRI engages in contract research and development for industry, government, trade associations and foundations. With a staff of about 300, it has completed over 3,000 scientific, engineering and economic projects.

is cooled to −40 F. and recycled to the first (fresh hydrogen) exchange column.

Gaining in concentration from 0.6 to 5 times normal, the gas stream from the hot extractor is also chilled to −40 F., then recycled to the second cold extraction tower. During the cooling, ammonia condenses out of the gas. It joins with the recycle ammonia from the distillation section and the main liquid ammonia stream to go to the hot extraction operation.

▶**And Now: Concentration**—Feed to the distillation section is the ammonia, concentrated 23 times in deuterium, that was vaporized in the evaporator. Passing through a battery of seven columns, the ammonia is concentrated to 75% deuterium. Lean ammonia is recycled to the extraction section.

The very small stream of greatly enriched ammonia is thrown in contact with demineralized water in still another column. Deuterium transfers to the water until equilibrium is reached, then the ammonia and water are separated. The ammonia is recycled; water is pumped to a Kuhn column (*Chem. Eng.*, Oct. 1956, p. 246) where 99.8% pure heavy water is recovered and process water is recycled for re-enrichment.

Novel Synthesis Nets New Chemical

What is believed to be a new compound, dichlorocarbene (CCl_2), has been synthesized via a comparatively simple process by M. Schmeisser of Aachen Technical University in Bonn, Germany.

Schmeisser reacts carbon tetrachloride vapor with carbon at 1,300 C. in an electrically heated corundum tube. System is held at a pressure of 10^{-3} mm. Hg. Product gas is cooled first with water, then in a trap with dry ice and, finally, in a second trap with liquid air. In this last trap, yellowish CCl_2 condenses. Yield is about 10 g. CCl_2 for each gram of carbon.

Dichlorocarbene has a melting point of −114 C. and a boiling point of −20 C. The compound decomposes during distillation at normal pressure to form hexachloroethane and hexachlorobenzene. The material reacts explosively with carbon; with oxygen it forms phosgene.

A number of German firms are actively exploring the industrial potential of the new chemical. Of possible commercial interest is the reaction of dichlorocarbene with butadiene to yield cyclopropane derivatives. Also, CCl_2 could be of interest for production of phenol-aldehydes for fragrances.

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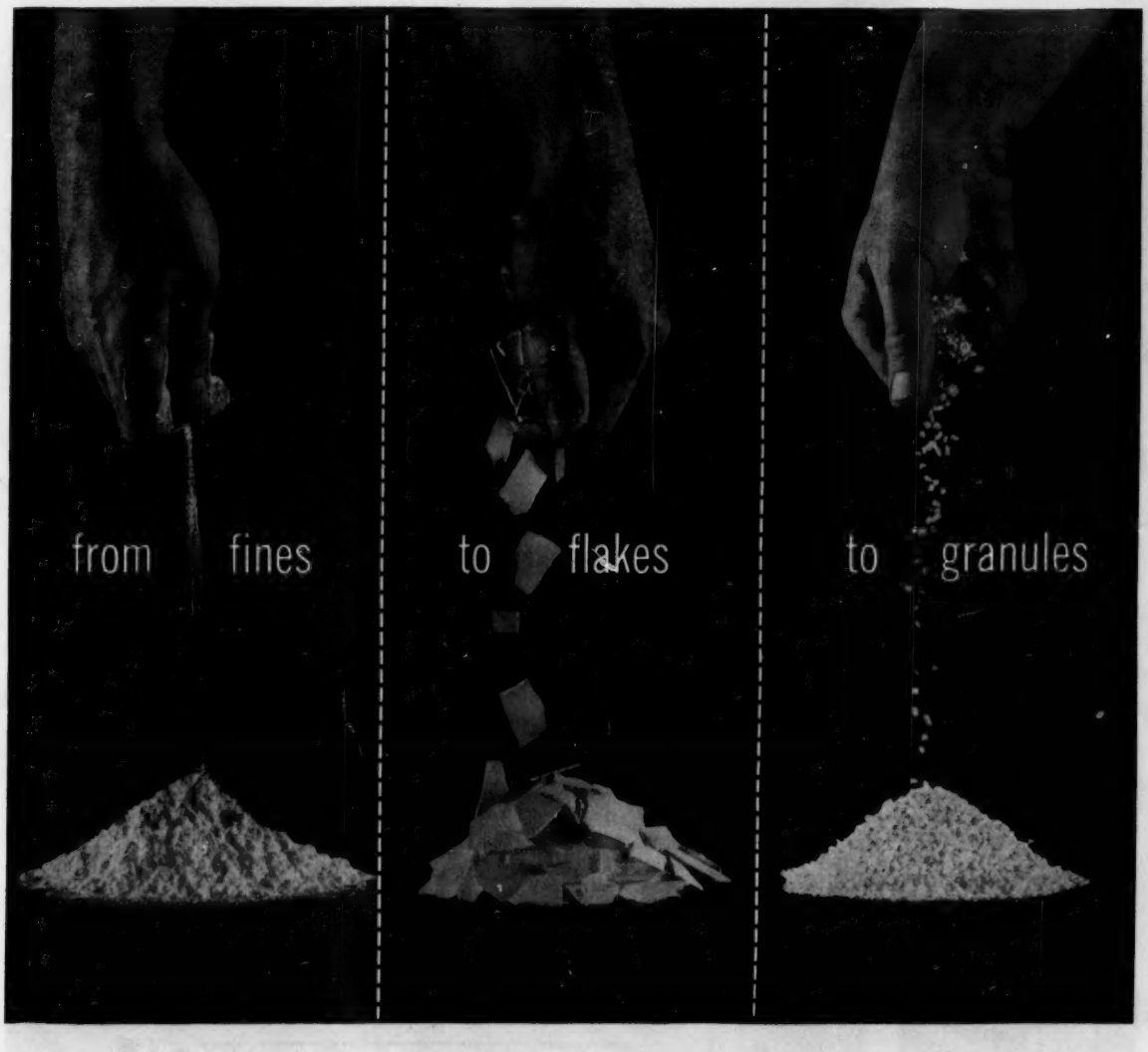

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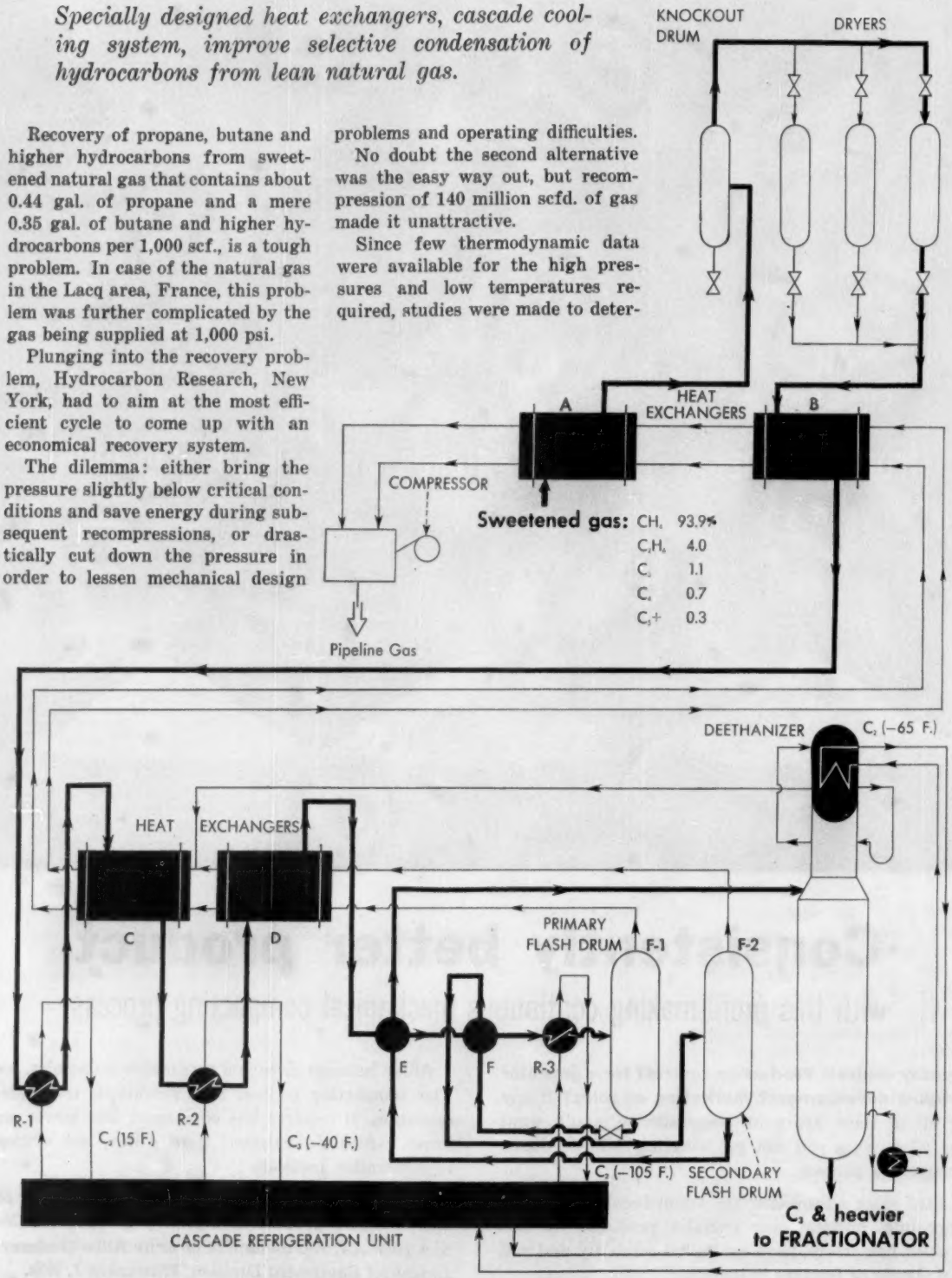
Recovery of propane, butane and higher hydrocarbons from sweetened natural gas that contains about 0.44 gal. of propane and a mere 0.35 gal. of butane and higher hydrocarbons per 1,000 scf., is a tough problem. In case of the natural gas in the Lacq area, France, this problem was further complicated by the gas being supplied at 1,000 psi.

Plunging into the recovery problem, Hydrocarbon Research, New York, had to aim at the most efficient cycle to come up with an economical recovery system.

The dilemma: either bring the pressure slightly below critical conditions and save energy during subsequent recompressions, or drastically cut down the pressure in order to lessen mechanical design problems and operating difficulties.

No doubt the second alternative was the easy way out, but recompression of 140 million scfd. of gas made it unattractive.

Since few thermodynamic data were available for the high pressures and low temperatures required, studies were made to deter-



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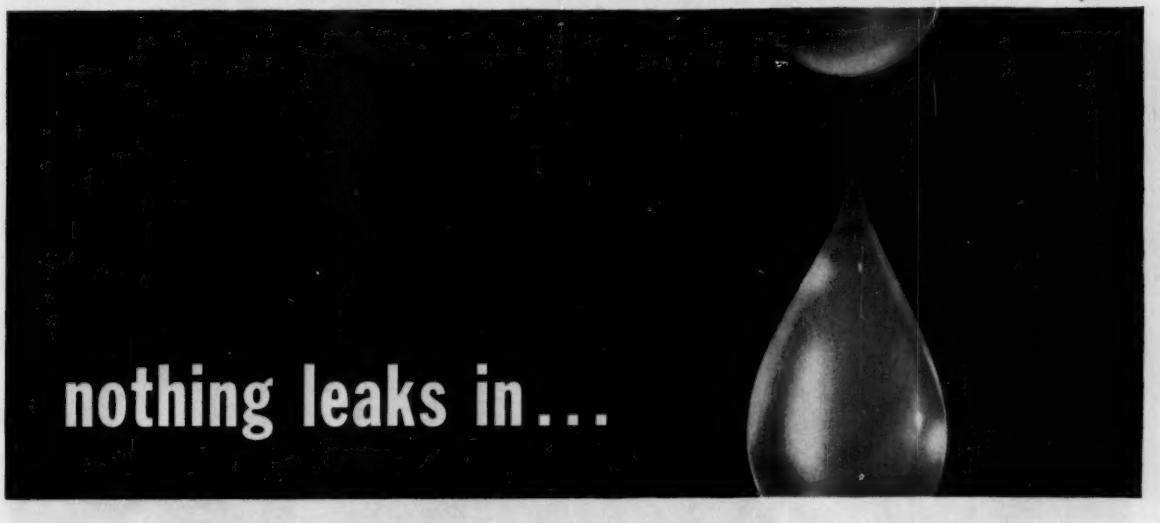

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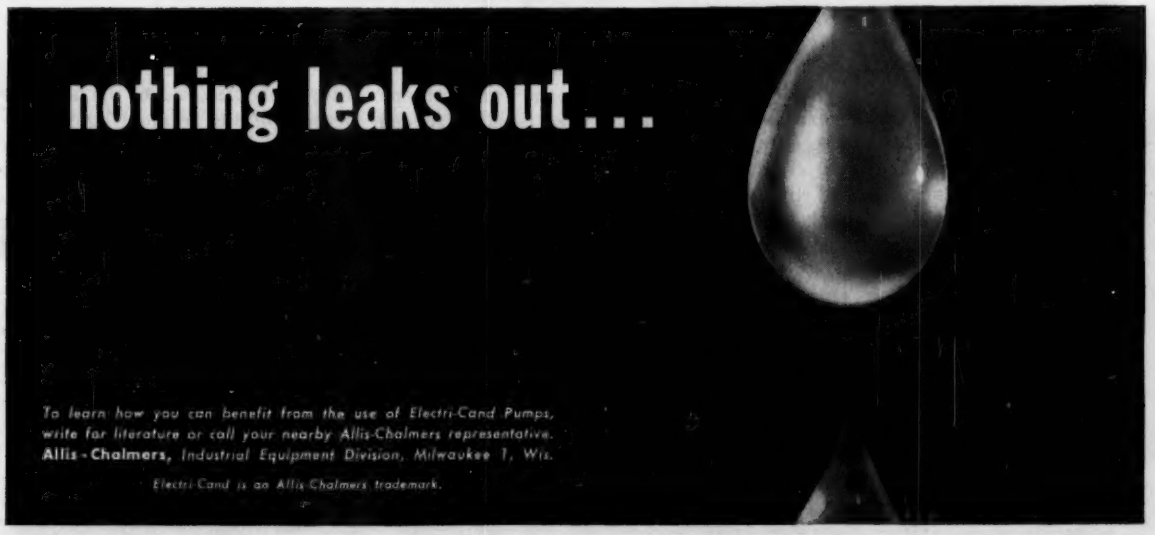
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Compressors and other equipment are installed in open-sided structures.

mine the properties of the Lacq gas and to find conditions best suited for its treatment. These studies gave a new approach toward improving the selectivity of condensation that was included in the final design of heat exchangers and the cascade refrigeration system.

▶ **Cooling of Feed Gas**—Heat exchangers *A*, *B*, *C* and *D* (*see flowsheet*) have some unusual features; they are of the counterflow, fixed tubesheet type. Heat transfer occurs between the feed stream in the shell and cold streams in the tubes so that a single exchanger can handle various cold streams at a particular temperature level. This design offers the advantage of eliminating parallel units for each cold stream and avoids the usual difficulties of dividing the feed.

Methanol injection prevents minute amounts of water (that slip through the dryers) from crystallizing and accumulating on the tubes during long on-stream periods. Exchangers operating at low temperatures are set vertically and the methanol is more effective in contacting the tube surfaces.

Further refrigeration is supplied in *R*-1 by evaporating propane at 15 F., in *R*-2 by propane at −40 F., and finally in *R*-3 by ethane at −105 F. More than 30% of the feed is condensed at the outlet of *R*-3 that discharges at −95 F. to the primary flash drum, *F*-1. Main bulk of the gas is then returned from the vapor space of *F*-1 through exchangers *D*, *C*, *B* and *A* to restore its refrigeration to the incoming feed.

▶ **Cascade System**—As previously mentioned, propane and ethane refrigerants are used. Propane makeup is obtained from the plant product. In the vapor-compression refrigeration cycle, propane is compressed, water-cooled, condensed and sent to *R*-1 and *R*-2. A stream of propane (−40 F.) from this circuit becomes the coolant for the ethane condenser of the ethane refrigeration circuit.

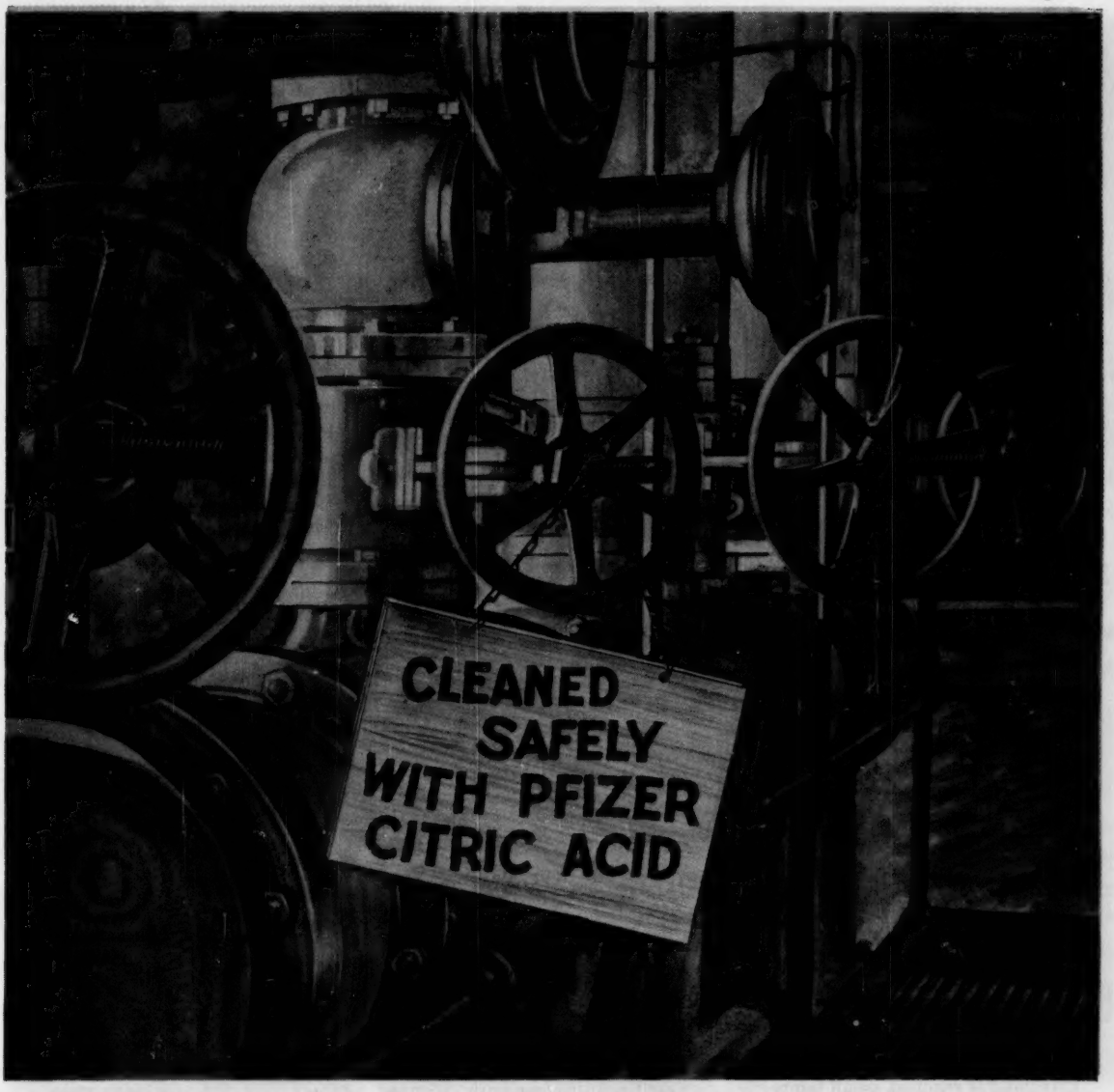
When ethane refrigerant is needed, a slip stream rich in ethane is withdrawn, stripped to 95% purity, and directed to the cooling system. This internal makeup results in significant reduction in refrigerant cost and assures controlled supply.

▶ **Refrigeration Recovery** — The liquid in *F*-1 contains a large amount of methane that should be removed to maintain high recoveries during fractionation. This is done, together with recovery of low-level refrigeration, by flashing the liquid through a valve before it enters exchanger *F*. The resulting vapor-liquid phase then enters flash drum *F*-2 for separation.

Both flashing operations, carefully controlled, reduce the methane content of the residual liquid to a tolerable level for purification in the tower. With temperatures and pressures tailored to this operation, propane loss is small and butanes and heavier hydrocarbons remain completely in the liquid phase.

▶ **Condenser on Top**—After cooling the feed gas in exchanger *E*, the liquid from *F*-2 enters the deethanizer. Methane and ethane are the overhead components that contribute to refrigeration recovery by mixing with vapor from *F*-2.

Insulated overhead piping, control instruments, overhead drum



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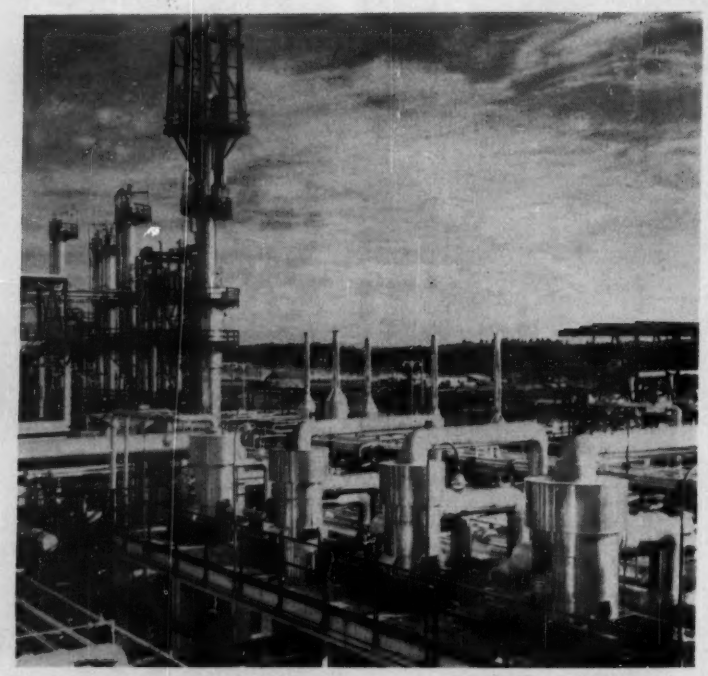

Vertical low-temperature heat exchangers in foreground and fractionating tower at left center are key units in the installation.

and a pair of reflux pumps are eliminated by placing the condenser on top of the deethanizer. From the ethane refrigeration circuit, a stream of ethane vaporizing at −65 F. takes care of condensing the reflux.

Throughout this process, temperature control is the key to high recovery. Once a temperature threshold is reached, small temperature changes cause large variations in amounts of condensation. Thus, it was exceedingly important to determine from an economic balance the proper terminal conditions to obtain high recovery with reasonable capital expenditure.

▶ **No Housing**—Taking full advantage of the mild climate of southwestern France, the gas plants in the Lacq field are of the open-type construction except for the fully enclosed control house. Compressors are set on a platform with a roof and open sides.

Another open structure houses normal-temperature heat exchangers, reflux drums and pumps. The hardware is on three decks for gravity flow: condensers and coolers at the top level; reflux drums and accumulators on the second level; and pumps on the ground level. All other equipment, including low-temperature heat exchangers, is at grade.

SNPA (Societe Nationale des Petroles d'Aquitaine), a government-controlled petroleum exploration and refining company, planned the processing facilities to go hand-in-hand with the field development. Accordingly, gas processing units have been added to handle additional production to keep up with the field expansion.

Units all follow the same general pattern:

1. Separation of the acid gases H_2S and CO_2 from the bulk of the gas.

2. Conversion of H_2S in the acid gas stream to sulfur in one unit and concurrent processing of sweetened gas in another unit to recover propane and heavier hydrocarbons.

The original unit, Phase I, built several years ago, had a raw-gas capacity of 1 million cu. m./day. Sweet-gas processing facilities of Phases II and III, handling 112 MM and 140 MM scfd, respectively, were designed, engineered and constructed by Hydrocarbon Research, Inc. These two plants, one started up in August 1958, and the other in June 1959, are in one of the richest natural gas supplies in the world. The Lacq gas, however, is one of the most difficult to process, for it shows about 15.4% H_2S and more than 10% CO_2 and inerts, leaving some 74% hydrocarbons. Yet, Phase III handling sweetened gas (typical analysis shown on the flowsheet), recovers all pentanes and heavier hydrocarbons, all butanes, and more than 80% of the propane. About 50% of the ethane in the gas is in the feed to the deethanizer from which ethane can be recovered. In fact, HRI is now erecting equipment to recover this ethane and convert it to high-purity ethylene.

The Lacq project has been of tremendous benefit to France, a nation that has chronically lacked fuel and power, will permit it a 10% cut in fuel imports. Gas reserves of the Lacq fields, which were first opened in 1951, are estimated in trillions of cubic feet. By 1962, the calorific value of natural gas production will be equivalent to some 6 million tons of coal or 1 billion gal. of fuel oil.

California Says Cloud Seeding Is No Cure-All

Three years of intensive investigation indicate that cloud seeding is no panacea for water shortages, according to Harvey O. Banks, California's director of water resources.

Commenting on a statistical review, covering an experiment to determine rainfall increase resulting from cloud seeding in Santa Barbara County, Banks says he feels he cannot justify the state's participation in the project any longer. "Cloud seeding, like salt water conversion, may be of some value in solving local water problems," Banks says. "However, for

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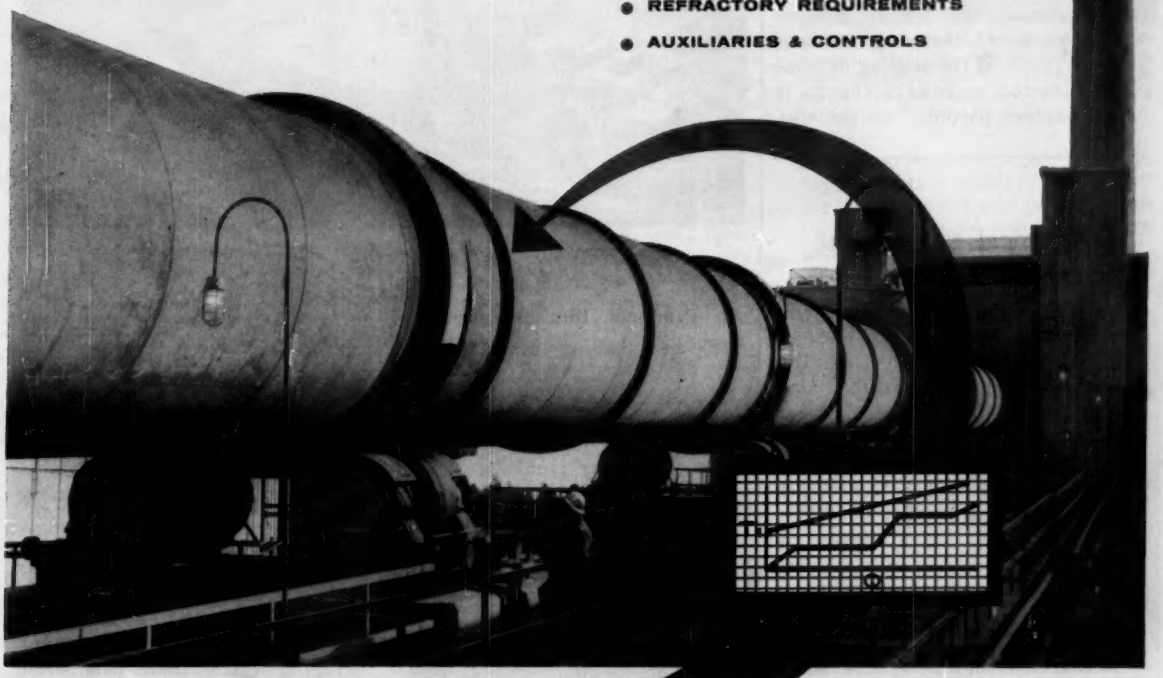

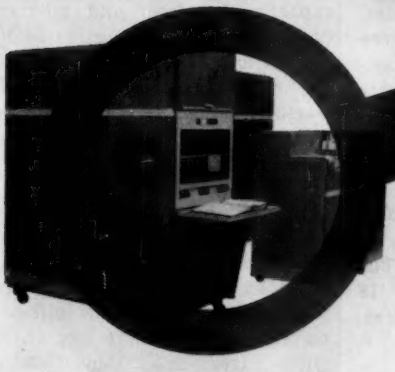

IBM 650 Data Processing System used by KENNEDY Engineers for Rotary Kiln Calculations.

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long-term solutions to regional water shortages, we feel the only real answer is in making better use of developed water and in further developing the vast amounts of undeveloped water now going to waste."

He notes the studies show there was some increase in rainfall during those storms in which clouds were seeded through a network of ground-based silver iodide smoke generators. "But we don't actually know whether the increase was a result of the seeding or some other factor, such as a change in the weather pattern," he declares.

A Chemical Engineering Approach to Shoemaking

The age-old art of shoemaking has yielded—at least in part—to modern engineering practice. This fall Mutual Shoe Sales Co., Maynard, Mass., is introducing a new line of shoes in which the sole and heel are molded simultaneously in one piece and attached permanently to the leather uppers.

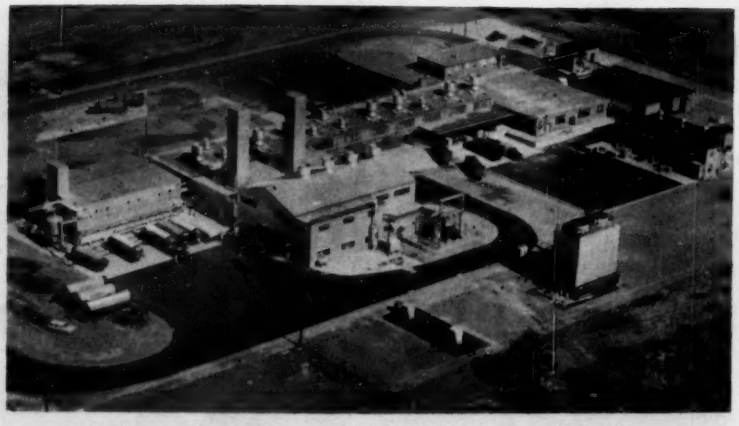
Made by the Vylar process, the shoes are now being manufactured in France by Chaussures Vylar. The one-step injection-molding process takes only a few seconds, is said to form a bond between the sole and upper that will not come apart for the life of the shoe.

Vylar will not reveal the composition of the material used to form the sole and heel. It is described only as a "chemical-resin compound; it is not a plastic as the term is generally used, nor is it a rubber." The synthetic, however, is said to form a shoe bottom that will outlast the leather uppers.

Eliminating sewing, tacking and gluing operations usually needed to attach soles and heels greatly speeds up shoemaking. One worker can now turn out 40 to 60 pairs a day; using conventional methods, he produces less than 12 pairs.

Vylar shoes, which will sell for about $10, will continue to be imported until a manufacturing plant can be set up here.

CPI Briefs



Air separation plant goes into production near Pittsburgh.

Air Products, Inc., recently dedicated its new $6-million liquid oxygen plant shown above. Facility is at Creighton, near Pittsburgh, Pa., can produce total of 200 tons/day liquid oxygen and nitrogen by low-temperature distillation of air. Plant also produces substantial amounts of argon, has facilities for distributing 3 million cu. ft./mo. of helium and 4.5 million cu. ft./mo. of hydrogen. Products are shipped by trailers and in cylinders, will go to customers in the steel, metalworking and chemical industries. The installation occupies a 22-acre site on the Allegheny River, is situated to complement many of Air Products' on-site oxygen plants at nearby steel mills.

Company also reveals that it has just put on stream a gaseous-hydrogen plant at Hopewell, Va., will start up a similar facility at Newark, N. J., in November. The Hopewell plant can produce 18 million cu. ft./mo. of hydrogen, with purity of over 99.9%.

Air Reduction Pacific Co. also makes news in the cryogenics field as it announces a million-dollar expansion of its air separation plant at Richmond, Calif. The move will boost plant capacity to over 65 tons/day of high-purity liquid oxygen, nitrogen and argon; it will include expansion of Air Reduction's existing separation unit at Richmond (which went on stream in March) plus construction of an additional 32-ton/day unit. The new construction is scheduled to be completed early next year.

U. S. Industrial Chemicals Co. has started up a new portion of its polyethylene plant at Houston, doubling the plant's capacity and bringing USI's total production capacity for low- and medium-density polyethylene resins to 300 million lb./yr. Company states that the move establishes it as the world's second-largest producer of the resin. (Largest: Union Carbide Plastics Co.)

Du Pont has announced plans for a major expansion and modernization of its sulfuric acid plant at Wurtland, Ky. Company will also establish a new bulk-acid terminal on a 70-acre site on the Ohio River, near New Cumberland, W. Va.

International Minerals & Chemicals Corp. is building a $500,000

CPI Briefs continues on page 224

ANACONDA CONDENSER AND HEAT EXCHANGER CLINIC

"Cupralum," lead-surfaced Anaconda copper tube, offers practical answers to some tough corrosion problems

If you'd be interested in more compact, more economical heat transfer units for handling corrosive liquors — sulfuric, chromic, phosphoric acids, sulfites, sulfates, alum, and the like — you should know about Cupralum*. Cupralum, a product of Knapp Mills, Inc., is Anaconda copper or copper-alloy tube to which a uniform, dense-structured, extruded chemical lead surfacing has been metallurgically bonded.

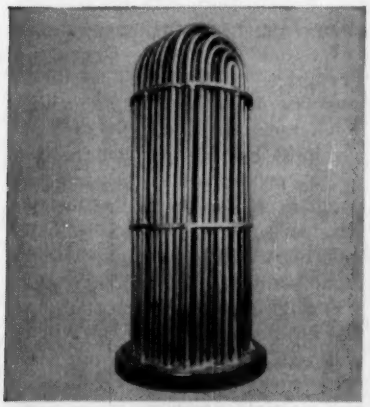
Alfred P. Knapp, chairman, Knapp Mills, Inc., explains to visitors how his company's patented drawing process metallurgically bonds lead surfacing to copper tube.

THE OUTSIDE lead surface, which may be from ⅛" to ½" thick, resists concentrations of acids—of sulfuric acid, for example, up to about 85% and up to 428 F. Being bonded to the copper, it expands and contracts with the copper during temperature cycling. Without the metallurgical bond, the lead would creep and eventually fail—an inherent weakness of all-lead tubing.

THE COPPER or copper-alloy tube inside provides strength to make Cupralum self-supporting — and to stand steam pressures up to 150 psi in standard wall thicknesses offered. It also provides its high corrosion resistance internally to cooling waters, steam, and refrigerants.

Most important, copper offers its high heat transfer rate. Because of the metallurgical bond with the lead, the over-all heat transfer rate of Cupralum is high—higher than all-lead tube and higher than that of iron and steel.

THE NET RESULT is that a given heat transfer job can be done with fewer square feet of surface — for a more compact unit. Or it is possible to get increased capacity in present existing space.



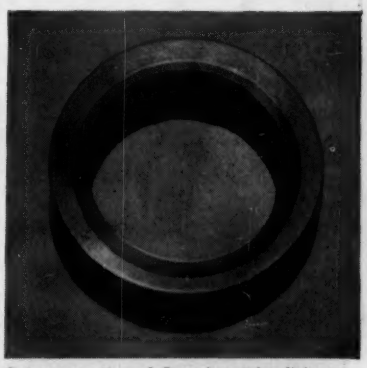
Two U-bend Cupralum tube bundles like this are used in a Ferrolum (lead-surfaced steel) separator tower to boil off ammonia from a urea carbonate ammonia solution—in the production of urea fertilizer. Anaconda copper tube core 1" O.D., 12 gauge, handles 150-lb. steam. Lead surface is ¾ inch thick. Separator tower operates at 145 C (293 F) and 240 psi.

Lead surfacing removed from ends of Cupralum tubes preparatory to insertion in lead-clad steel tube sheet. Tube ends are usually rolled, but for severe thermal cycling service, may be brazed to outer steel face of tube sheet.

In many cases, the first cost of the coil is lower. Usually this is true where higher steam pressures than those previously used are available—or where expensive, hard-to-fabricate alloys have been used. Improvement of the heating or cooling cycle is another source of savings. Under any circumstances, a long operating life and easy maintenance provide over-all economy.

NUCLEONIC APPLICATIONS. Cupralum with a thicker surfacing of lead is being used increasingly in the nuclear industry. For gamma shields that must be cooled, Cupralum coils are built in to provide efficient heat transfer from the shield to the cooling medium.

Where radioactive liquors and spent resin discharge from demineralizers must be conveyed through process piping into process vessels for concentrating the radioactive solution, Cupralum piping prevents the escape of gamma radiation. In nuclear applications, the lead surfacing may be 1" to 8" thick.



Cutaway section of Cupralum tube. It is produced in 20' lengths or in long continuous coils —from 40' to 100' depending on diameter. It is easy to bend and fabricate. Reliable jointing techniques have been developed.

Lead surfaces of Cupralum tubes and of tube sheet are fused by lead-to-lead welding. Then an extra thickness of lead is applied at the joint for extra protection.

FOR MORE INFORMATION. For detailed data on Cupralum, write Knapp Mills, Inc., Wilmington, Del. Or see your Anaconda representative, who can also provide data on the full line of Anaconda copper and copper-alloy tubes—arrange for technical assistance in meeting special corrosion and heat transfer problems. The American Brass Company, Waterbury 20, Conn. In Canada: Anaconda American Brass Ltd., New Toronto, Ont. 6071

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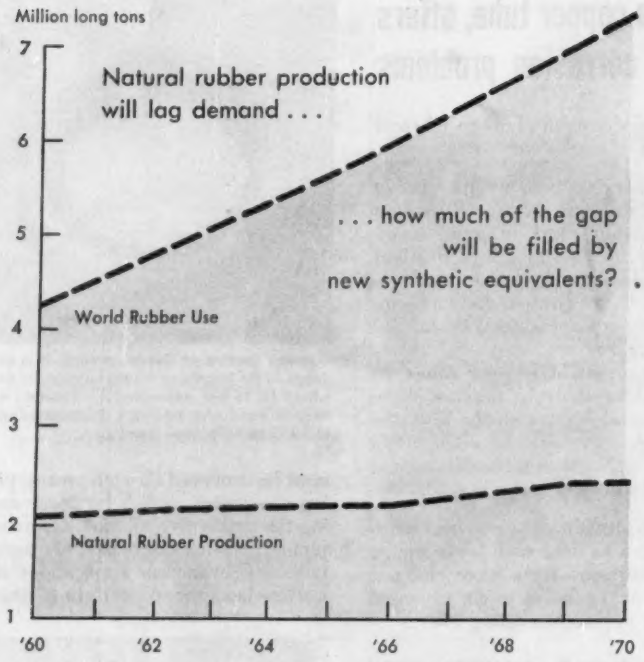


. . . Industry estimate: 195,000-ton/yr. capacity by 1962.

Company	Products	Long Tons/Yr.
Shell	Polyisoprene	60,000
Phillips	Polybutadiene	25,000
Firestone	Polyisoprene-polybutadiene	30,000
Goodyear	Polyisoprene-polybutadiene	25,000
Goodrich-Gulf	Polyisoprene-polybutadiene	25,000
American Rubber & Chemical	Polyisoprene-polybutadiene	30,000

TREE RUBBER'S SUCCESSORS READIED

FRANCES ARNE,
Associate Editor

Hardly a week goes by without revealing new planned capacity for natural rubber's synthetic duplicate, polyisoprene, or for its partial replacement, polybutadiene. By the end of 1961, there will be a total U.S. capacity of at least 195,000 long tons of one or the other. In contrast, aside from pilot production, there is currently only 1,500 tons/yr. of polyisoprene, coming out of Shell Chemical's Torrance, Calif., plant and 500 tons/yr. of polybutadiene, produced by Phillips Chemical at Borger, Tex.

▶ **Why All This** — For several years, high industry officials have been predicting a natural rubber shortage and, in the next breath, commercialization of polyisoprene for the early 60's. World consumption of natural rubber had already reached about 1.9 million long tons in 1959. Expectation is that the amount available will shortly level off to an inflexible 2 to 2.3 million long tons annually. Primarily responsible for arresting production growth: insufficient replanting of rubber trees in politically disturbed Indonesia, formerly the world's largest supplier of natural.

Though synthetic rubber is expected to increase its share of U.S. consumption to 67.4% in 1960, natural rubber—or its full equivalent—has a lock on a substantial volume of heavy-duty use by virtue of superior resistance to heat buildup.

▶ **Why Now**—Trigger to the recent quick barrage of announcements of capacity for rubbers that duplicate natural rubber properties was probably the latter's current price. It recently hit 47¼¢/lb., about as high as it's been in the past two years, a poor contrast with the stable 23¢/lb. price of SBR and the 30¢/lb. at which Shell sells polyisoprene. Quoting one industry spokesman, "Any guy with a slide rule can see that you can make polyisoprene cheaper than that."

Three U.S. companies will be going on stream with new synthetic-natural capacity by January 1961. Three others will become factors by year's end. Total capacity proposed: 170,000 tons.

Of these companies, all but Shell name polybutadiene as an alternate product for their new capacity. In addition, Phillips Chemical expects to complete a 25,000-ton/yr. polybutadiene plant by the fourth quarter of this year, has licensed its process to two companies in the U.S., one in Italy. Germany's Chemische Werke Huels has developed two new processes for making polybutadiene. Shell Netherlands Chemical has started construction of a polybutadiene-polyisoprene plant in Holland and Societe des Elastomers de Synthese is blueprinting a 25,000-ton/yr. polybutadiene plant for Berre, France.

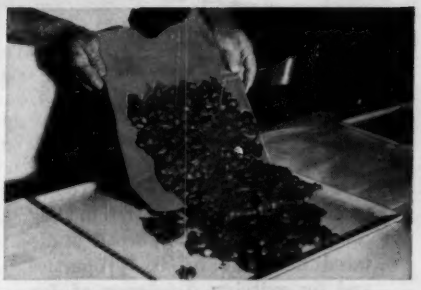
▶ **Foreign Angles** — Compounding the effects of the natural rubber shortage, the following sequence of factors may have further influenced the multiple decisions to go commercial with the new polymers:

- Foreign markets for rubber are growing considerably faster than mature U.S. markets.
- Percentage of natural in for-

SILICONE NEWS from Dow Corning

New Process Aid

Silicone Coated Papers Speed Processing of Sticky Products



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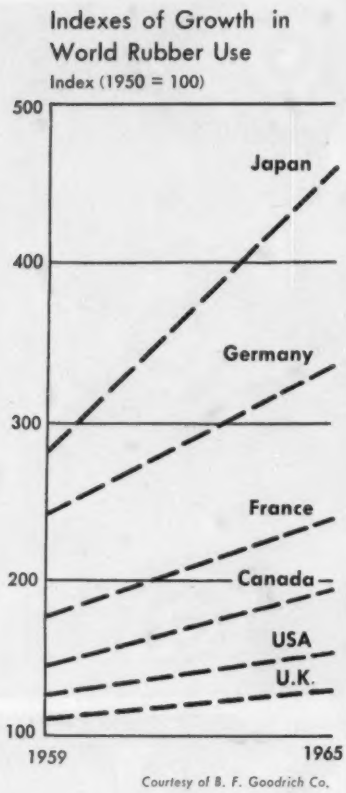
Projections favor New Synthetics



Courtesy of B. F. Goodrich Co.

eign consumption is over 70 compared with the 33.6% share expected of U. S. consumption in 1960. Natural's dominance abroad is dictated not only by its properties, and by existing deficiency of foreign synthetic capacity, but also by preference. This preference has persisted though U. S.-made SBR rubbers have consistently been priced abroad substantially below natural's price. Synthetic natural rubbers—wherever produced—will inherit from tree rubber a more favorable climate for growth abroad than has been the lot of SBR.

• More adaptable U. S. markets will turn increasingly to readily available synthetic natural rubbers for their heavy-duty needs in the face of avid foreign competition for tight supplies of tree rubber.

In fact, despite the unfavorable climate, U. S. exports of synthetic rubber climbed from 93,734 long tons in 1955 to 290,468 in 1959; exports through the first six months of 1960 already totaled 192,858 long tons. However, U. S. observers look for the downturn around every corner because foreign synthetic capacity is climbing and, based on announcements to date, is expected to reach 900,000 long tons in 1963.

▶ **Insurance for Exports**—Foreign capacity announced for synthetic natural is minor compared with U. S. plans. In general, the superiority of our technical know-how to the outside world's is receding, but processes for isoprene production and polymerization are acknowledged exceptions. As demand for U. S.-made SBR dwindles abroad, demand for U. S. synthetic natural rubbers may step in so that exports remain an important factor to the U. S. rubber industry.

During the past decade, rubber consumption in the U. S. has increased about one third to an expected 1.64 million long tons in 1960. Consumption in the free foreign world has nearly doubled to reach about 1.68 million long tons. The growth rate in the Soviet bloc has been even faster, possibly tripling over the past ten years to about 930,000 long tons.

Greater rate of growth abroad is expected to continue and worldwide rubber consumption is expected to increase by two thirds over the next ten years. Including the new synthetic equivalents of natural rubber, three pounds of synthetic rubber for each pound of natural is the consumption ratio predicted for the U. S. in 1970. Consumption ratio overseas will most likely amount to almost three pounds of synthetic for every two of natural, which approaches the percentage at which the U. S. industry is operating. Total world rubber demand is expected to go from 4.2 million long tons in 1960 to 7 million in 1970.

▶ **Protected Bets**—Most producers-to-be of natural rubber's synthetic equivalents are protecting their bets by planning to alternate production of polybutadiene and polyisoprene in the same facilities. Polybutadiene is the popular choice for a starter, probably because monomer is more available and cheaper at present.

Polyisoprene is looked upon as a complete replacement for natural rubber while polybutadiene is viewed as an extender for natural rubber. However, research in progress may bring polybutadiene close to a replacement position.

▶ **End-Product Flexibility** — Both polyisoprene and polybutadiene are stereospecifics made through similar solvent polymerization processes (a hydrocarbon solvent such as kerosene and a lithium or aluminum alkyl catalyst) while conventional synthetic rubber is made by emulsion polymerization. Other new stereospecific elastomers also heading for commercialization are ethylene-propylene and ethylene-butylene copolymers for which Montecatini is building a 20,000-ton/yr. plant in Brindisi, Italy. Presumably capacity for solution polymerization flexible enough to alternate between two stereospecific polymers could switch to others, should markets develop in other directions.

▶ **Raw-Material Flexibility** — Another research problem has been low-cost isoprene monomer for polyisoprene, and companies are reluctant to discuss their solutions. Isoamylene or propylene are frequent guesses as to most economic starting material (*Chem. Eng.*, Sept. 5, 1960, p. 60).

Companies do confidently predict, however, that polymerization-grade isoprene will be produced to sell for no more than butadiene. Some also speculate that, when this occurs, not only will isoprene be available for polyisoprene, but also for modification of conventional emulsion-type rubbers.

A sizable volume of work during the government rubber program showed that there was little to choose in terms of performance between emulsion polymerized rubbers made from either of the two dienes. Moreover, isoprene rubbers are more useful in making chemical derivatives (chlorinated products, etc.) than butadiene rubbers. Thus, isoprene has prospects of becoming a serious competitor to butadiene in SBR rubber manufacture.

Engineering Progress Report

FROM UNION CARBIDE CHEMICALS COMPANY

Acetonitrile boosts butylene throughput 58%, saves $3,000,000 capital investment

Unusual solvent useful in saturate-unsaturate and olefin-diolefin separations

By using acetonitrile as an extractive distillation solvent, Shell Chemical Corporation has boosted throughput of the existing butadiene feed-preparation unit 58% in their Torrance plant. Minor engineering changes for the unit cost $148,000: it has been estimated that a similar throughput increase through new construction would cost about $3,000,000. Development work and operating experience have shown that acetonitrile's unusual solvent properties should prove useful in other saturate-unsaturate and olefin-diolefin separation processes.

ADVANTAGES OF ACETONITRILE

Acetonitrile has boosted capacity in the Shell plant because it increases the spread in boiling points of the C_4 hydrocarbons being distilled. Thus, separation of the hydrocarbons is more efficient than with either acetone or furfural. Relative volatility of n-butane compared to butene-1 is about 1.25 with acetone and about 1.30 with furfural. Acetonitrile increases this ratio to almost 1.4. The spread in boiling points of butene-1 and butadiene is also increased. The table gives data on the relative volatilities of C_4 hydrocarbons in aqueous acetonitrile systems.

After the extractive distillation has been completed, acetonitrile can be completely recovered from the butane and butylene streams with greater ease than acetone. This increased recovery efficiency is due to the high distribution coefficient of acetonitrile in water/hydrocarbon systems.

ENGINEERING CHANGES MINOR

Because of the similarity of the physical properties of acetonitrile and acetone, it is not necessary to change the operating pressure of extractive distillation columns. Shell engineers made only minor changes to their unit. Besides a larger reboiler and a new pump, two heat exchangers were switched and the solvent recovery column was connected to vacuum operation. Aqueous acetonitrile systems do not foul exchanger systems. Corrosion due to hydrolysis of solvent at reboiler temperatures is minimized by pH control.

TABLE 1 RELATIVE VOLATILITIES OF THE C_4 HYDROCARBONS IN AQUEOUS ACETONITRILE, 120 psia

Component	Total Solvent Concentration, 80%m		Total Solvent Concentration, 85%m	
	Water in Solvent 15%m	Water in Solvent 25%m	Water in Solvent 15%m	Water in Solvent 25%m
Isobutane	1.638	1.673	1.637	1.674
n-Butane	1.332	1.347	1.348	1.368
Isobutylene	1.013	1.013	1.013	1.013
Butene-1	**1.000**	**1.000**	**1.000**	**1.000**
t-Butene-2	0.861	0.856	0.865	0.861
cis-Butene-2	0.821	0.813	0.827	0.820
Butadiene-1, 3	0.639	0.599	0.645	0.604
Water	0.08	0.045	0.075	0.045
Acetonitrile	0.043	0.033	0.043	0.033

OPERATING COST REDUCTIONS

The butadiene feed-preparation unit operating on acetonitrile has less solvent-loss than one operating on acetone. *Thus, solvent make-up costs are no higher with acetonitrile than with acetone.* Steam and pumping costs have also been reduced because reflux and circulation rates are lower. This is true even at reduced feed rates.

ACETONITRILE USEFUL IN OTHER PROCESSES

Acetonitrile is effective in other saturate-unsaturate and olefin-diolefin separations. This heat-stable extractant is useful in ethylene-ethane, propylene-propane, and cyclopentadiene-cyclopentane separations. The boiling point spreads between pentadienes, such as isoprene, and pentenes are also increased.

In liquid-liquid extraction processes, acetonitrile is effective in removing tars, phenols, and color bodies from hydrocarbons. Acetonitrile is also useful as a selective solvent for fatty acids.

INFORMATION AVAILABLE

If you're looking for increased efficiency in your extractive distillation or liquid-liquid extraction processes, acetonitrile could be the answer. Detailed information on acetonitrile as an extractive distillation solvent along with information on azeotropic mixtures of acetonitrile is available. For this information, call the nearest CARBIDE Technical Representative—or write, Department B, Union Carbide Chemicals Company, Division of Union Carbide Corporation, 270 Park Avenue, New York 17, New York.

Nothing herein shall constitute a recommendation to practice any invention covered by any patent without permission of the patent owner.

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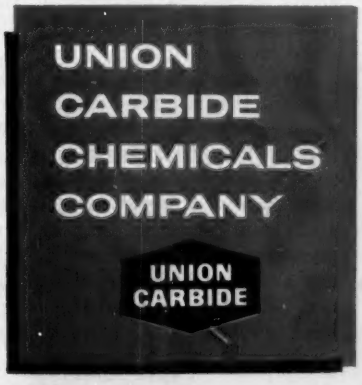


PINPOINTED: CONCENTRATION OF CHEMICAL PLANTS

A new county breakdown of chemical processing plant concentration, based on McGraw-Hill's Census of Manufacturing Plants for 1959, reveals that the chemical process industries do not follow the overall pattern of U. S. industrial concentration.

The original census established that 7,711 chemical processing plants, or over 58% of the country's total, are located in 66 major industrial areas selected from the U. S. Census by the Director of McGraw-Hill Research (*Chem. Eng.*, Nov. 2, 1959, p. 36). The new breakdown by counties shows that, while the major industrial areas embrace 160 counties, 5,691 or 50% of the chemical industry plants are in 66 counties.

Four counties in this upper 50% are not within major industrial areas: Bexar, Tex., with 0.34% of the nation's total plant concentration; Henrico, Va., with 0.30%; Norfolk, Va., with 0.29%; Mecklenburg, N. C., with 0.27%.

With this narrower focus, the sequence of locations with heaviest plant concentrations shifts. Cook County, Ill., with 5.83% of the plants comes out on top followed by Los Angeles; Philadelphia; Wayne, Mich.; Kings, N. Y. Sequence shown by the original breakdown by major industrial area: New York-Northeastern N. J.; Chicago-Gary, Ind.; Los Angeles; Philadelphia; Boston.

Ten top CPI counties

	% of U.S. Plants*
Cook, Ill.	5.83
Los Angeles, Calif.	4.50
Philadelphia Pa.	1.74
Wayne, Mich.	1.71
Kings, N. Y.	1.60
Cuyahoga, Ohio	1.45
Essex, N. J.	1.44
New York, N.Y.	1.33
Harris, Tex.	1.13
Baltimore City, Md.	1.08

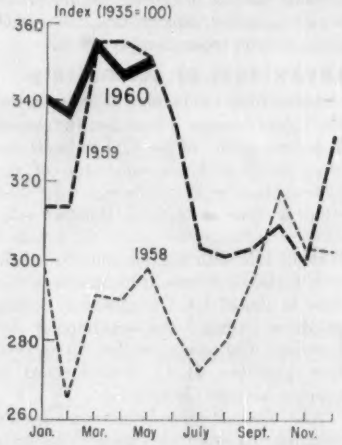
*With 20 or more employees.

For full details of the new county breakdown, write for Chemical Process Industries Report No. 120-10S, c/o Chemical Engineering, Market Research Manager, 330 West 42nd St., New York 36, N. Y.

Minimum size plants are required for economical operation to produce most chemicals. According to the report, "At the present time the demand for many chemicals in the Pacific Northwest is approaching or already exceeds quantities which justify local production. An example of this is the decision of Dow Chemical to build a phenol plant at Kalama, Wash. — announced early this year.

"Within the next few years the production of methanol from petroleum should be feasible; production of urea could start up in the near future. Expansion in the production of synthetic ammonia (already produced at 265 tons/day) is almost a certainty."

Chemical Consumption Index



	Apr. (Final)	May (Est.)
Coal products	9.5	9.6
Explosives	12.0	12.4
Fertilizer	81.0	85.6
Glass	27.7	29.4
Iron & steel	17.9	16.2
Leather	4.2	4.4
Paint & varnish	42.9	41.7
Petroleum refining	31.0	32.0
Plastics	34.8	34.7
Pulp & paper	42.0	42.8
Rayon	24.1	25.1
Rubber	7.4	7.4
Textiles	9.9	10.4
Total	344.4	351.7

Northwest Chemicals Diversify, Integrate

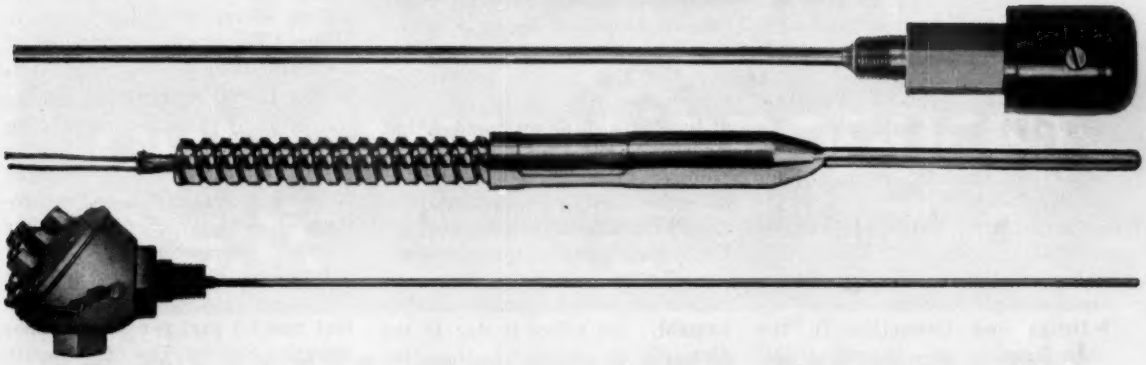
The chemical industry in the Pacific Northwest is no longer exclusively geared to demands of the pulp, paper and those of the plywood industries.

Diversification has been under way for the past five years: There are now seven large petroleum companies with refineries in the region, representing an investment of over $200 million. Natural gas is available from pipelines, and sulfur, phosphorus and other raw materials are available from smelters. The first petrochemical plant started up near two refineries the early part of this year.

As the first report in a series on industry groups in the Pacific Northwest, the Puget Sound Power & Light Co. has published these observations in a brochure on "The Chemical Industry in the Pacific Northwest." The report lists 29 chemical companies in the three states of Washington, Oregon and Idaho plus western Montana as well as in southwestern British Columbia.

It predicts that within ten years three more large companies will locate refineries on Puget Sound. Combined refinery crude capacity should increase to approximately 300,000 bbl./day, which will provide a broad base for petrochemical production.

CHOOSE FROM 150,000 STANDARD *MegopaK* SMALL-DIAMETER THERMOCOUPLES



If you've been looking for small-diameter, flexible thermocouples with high speed of response, search no more. You'll find exactly what you need in Honeywell's *MegopaK** line.

MegopaK is a combination of thermocouple wires, mineral insulation and a protecting sheath, compacted into a solid mass with a diameter as small as 1/16". You can get *MegopaK* in standard lengths up to 25 feet, and in lengths up to 50 feet on special order. They're available with copper-constantan, iron-constantan and *Chromel-Alumel*** calibration. In all, there are more than 150,000 standard combinations of materials and fittings. These top-quality thermocouples are supplied in bulk, and as elements with wires welded into a measuring junction, or as complete assemblies.

*Trademark, Minneapolis-Honeywell Reg. Co.

**Trademark, Hoskins Mfg. Co.

MegopaK assemblies come complete with terminations (heads, plugs, etc.) and mounting attachments. Also available are special configurations, tests, material and calibration certifications.

MegopaK thermocouples and other pyrometer supplies are stocked at our Los Angeles and Dallas depots as well as in Philadelphia to give you the fastest possible service anywhere in the country.

Check with your nearby Honeywell field engineer for complete details, or write for Catalog G100-4.

MINNEAPOLIS-HONEYWELL, Wayne and Windrim Avenues, Philadelphia 44, Pa.
—In Canada, Honeywell Controls, Ltd., Toronto 17, Ontario.

Honeywell

75th YEAR PIONEERING THE FUTURE

First in Control SINCE 1885

SILICA'S HORIZON WIDENS

Fine silica particles, a hundred times smaller than average particle of tobacco smoke, perform big tasks in industry.

Two new types of silica, each with a high surface area of about 280 sq. m./g., are now commercially produced by a special process for which patent application has been made. They are soft, white, microfine particles sized from 9-15 millimicrons and could readily float in air. Surface forces, however, cause them to agglomerate so they are not especially difficult to handle.

One type of microfine precipitated silica, called Quso F 20, is slightly acidic (pH 5.9); the other, Quso G 30, is on the alkaline side with a pH of 8.2. Both are hydrophilic and insoluble, with a high oil absorbency.

In industry, their applications run the gamut from insecticides and cosmetics to thermal insulations and plasticizers.

▶**Drugs and Cosmetics**—In the manufacture of pharmaceutical products, addition of a small percentage of Quso decreases breakage in handling and aids in release from the molds.

Nontoxic characteristics plus absorptive capacity that results from its extensive surface area and pore structure make this silica an effective bodying agent for creams or ointments, antacids and similar types of medication. When dusted on the skin, it clings with amazing tenacity. Such action is important in bases for antiseptic or cosmetic powders.

▶**Doesn't Melt**—In extruding certain types of resins, particularly the epoxies, the plasticizing action of Quso is striking. Strength, too, is improved in many cases so that the molded plastics show marked resistance to distortion by temperature change.

Quso is readily dispersed in oil by use of mills that give a shearing action. The resultant grease shows little viscosity change between wide temperature extremes. Even more striking, it does not melt when heated to a point where the oil itself would decompose.

As a water suspension, it can be sprayed or padded on kraft paper to give a marked increase in resistance to slippage. Antiskid paper of this kind is growing in importance for the manufacture of bags and shipping cartons that must be handled on pallets.

▶**Better than Glass Fiber**—Another interesting characteristic is Quso's excellent thermal insulating value. In this respect, it is far superior to such things as cork, rock wool, or even glass fiber. Presumably, the effect is due to the film of air held by the tiny particles.

Quso F 20 has been found very effective for flatting nitrocellulose lacquers. It offers great suspending action, resistance to overgrinding and, by virtue of its slight acidity, prevents degradation of other lacquer ingredients.

▶**Kills Insects**—Cockroaches and similar waxy-shelled pests are rapidly destroyed by brief contact with finely divided silicas. The product is not toxic to most animal life but it adsorbs the surface wax of certain insects, resulting in their dehydration and death. And it is suitable for combination with insecticidal poisons where that is desired.

The silicas are available in 25-lb. paper bags, at prices ranging from 55-70¢/lb. — **Philadelphia Quartz Co., Philadelphia, Pa. 110A**

Silicon

Semiconductor material offers high purity and maximum uniformity.

High-purity silicon in polycrystalline form, produced via the Siemens-Westinghouse process of trichlorosilane decomposition ($H_2 + HSiCl_3 \xrightarrow{heat} Si + 3HCl$), can be converted by vacuum-zone refining to single-crystal form having typical resistivity greater than 1,000 ohm- centimeter and a lifetime of minority carriers greater than 400 microseconds.

Polycrystalline rods have 0.1 part per billion acceptor impurity content and 1.0 part per billion donor impurity content. Use of ultrapure trichlorosilane and carefully controlled production techniques produces high uniformity throughout the length of individual rods and from rod to rod.

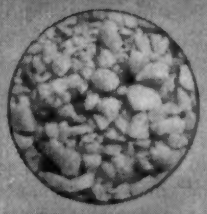
Available ($300/lb. and up) in various diameters up to 1 in. and lengths to 17½ in., these rods are suitable for zone refining to the single-crystal silicon used in power rectifiers, transistors, diodes and other devices.—**Dow Corning Corp., Midland, Mich. 110B**

Growth Retarder

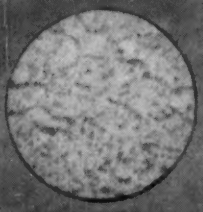
New sprayable compound reduces nursery losses.

Recently introduced by UBS Chemical, Rutex is a sprayable compound primarily developed to

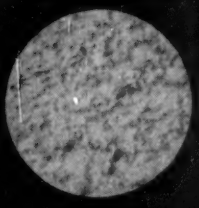
OUTSTANDING FORMS!



FLAKE. Recently developed for users requiring a product that always flows freely. Dissolves rapidly. No extra cost!



REGULAR GRANULAR. Fast dissolving, yellow-white, crystalline material for a wide range of applications.



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Sodium Nitrite • Caustic Soda • Calcium Chloride • Chlorine • Chloroform Caustic Potash • Potassium Carbonate • Sodium Bicarbonate • Soda Ash Ammonium Chloride • Methyl Chloride • Ammonium Bicarbonate • Vinyl Chloride Methylene Chloride • Cleaning Compounds • Hydrogen Peroxide • Aluminum Chloride • Mutual® Chromium Chemicals • Snowflake® Crystals • Monochlorobenzene • Ortho-dichlorobenzene • Para-dichlorobenzene • Carbon Tetrachloride

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- ☐ Solvay 45-S Granular Sodium Nitrite
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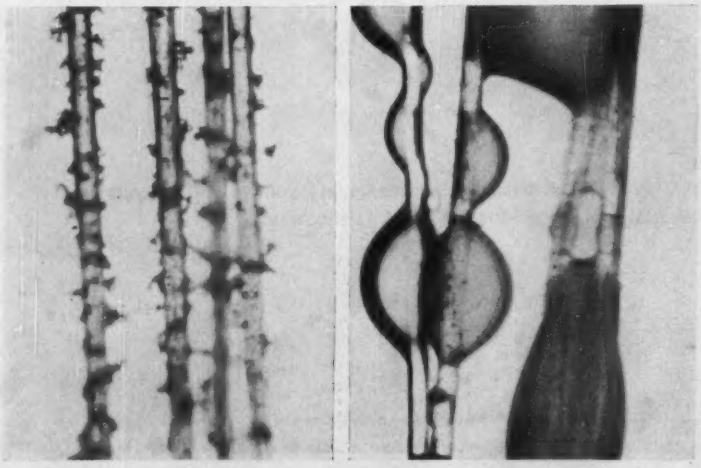
Dye-solvent carrier shortens dyeing cycles



When a dye-precipitated carrier, such as benzoic acid, is used with disperse dyes, the dye carrier precipitate builds up around a polyester fiber as shown on the left.

A dye-solvent carrier, such as Cyanotex EM, forms colored globules that attach themselves to the polyester fiber as shown on the right. This new product increases the rate of dyeing and promotes exhaustion of the dye bath used for polyester, triacetate and acetate fibers. Better color values are achieved and the dyeing cycle can go on at lower temperatures.

Effective over a pH range of 5.5 to 9.5, at temperatures up to 180 F., Cyanotex EM also reduces staining when dyeing mixtures of polyester or triacetate with wool or cellulosic fibers. It does not reduce the light fastness of dyeings even when it is not completely removed from the treated material. This eliminates strongly alkaline afterscour to remove the carrier.

With Cyanotex EM, a dyer can produce its effect in one hour, while without the carrier it may require 24 to 50 hours.—American Cyanamid Co., New York, N. Y. 112A

reduce dehydration losses of plants.

The dormant storage of nursery stock, which begins as early as September in the North, is an annual ritual for American nurserymen. Although uprooted plants in storage are protected against dehydration through mechanical refrigeration and water absorbent packing, a significant number have never survived.

Rutex forms a spongelike film on plant stems and roots that swell in contact with water. Since it keeps a moisture balance, this compound acts as a direct substitute for moss, peat and shingletow which are bulky and heavy, require hand packing and involve great freight costs. Bud growth, a devitalizing process that cripples nursery stock before planting, is retarded by Rutex spray.—**UBS Chemical Co., Div. of A. E. Staley Mfg. Co., Cambridge, Mass.** 110C

Protective lining

Zinc coating stretches water-tank life, reduces repair time.

A new lining material, Carbo Zinc #11, gives galvanic protection and prevents rusting of industrial water tanks.

Using this inorganic zinc system, it is now possible to apply a single coat over commercial sand-blasted steel, allow 3 hr. curing time and have the tank back in service in less than the 24-hr. repair period allotted by safety regulations.

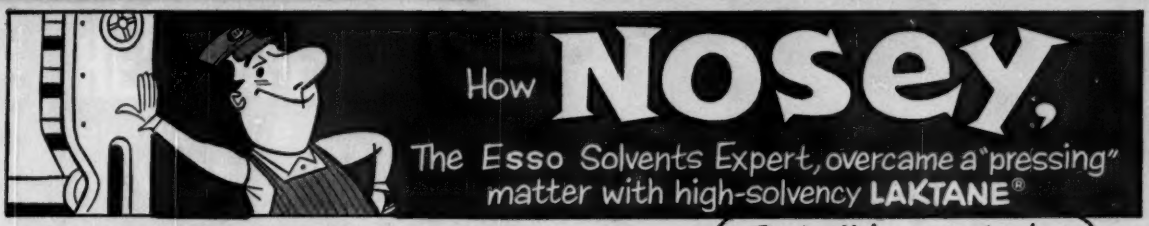
This zinc coating becomes water-insoluble 20 min. after application. It can be applied under adverse weather conditions at subfreezing temperatures and 100% humidity without affecting its physical properties. Until now, it has never been practical to apply good protection to steel because surface preparation, application and curing of standard coatings require two to three-day shutdown. The life expectancy of Carbo Zinc #11 coating is from two to seven years, depending on the type of water, rather than the present one-year shutdown repair period.—**Carboline Co., St. Louis, Mo.** 112B

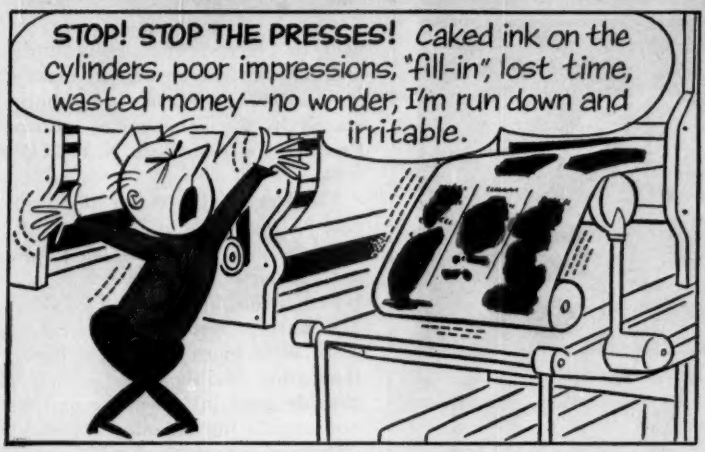
Newsworthy Chemicals

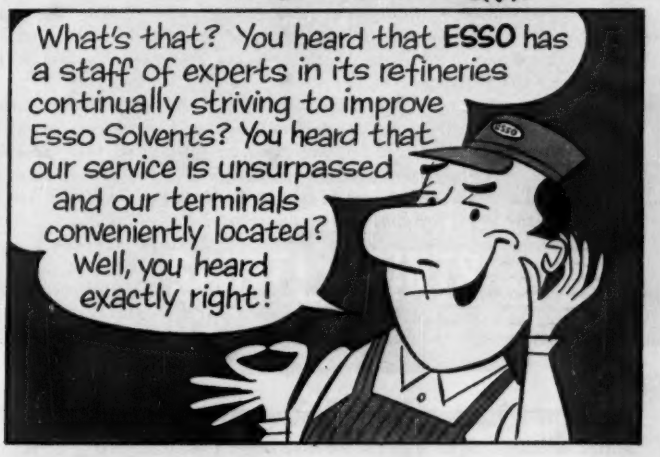
Page number is also reader service code number

Microfine silica for insecticides, insulation, cosmetics..... 110A
High-purity silicon yields single-crystal form..... 110B
Growth retarder reduces nursery losses..... 110C
Dye-solvent carrier shortens dyeing cycles..... 112A
Zinc coating provides galvanic protection..... 112B
Amine hardener used for rocket's gas containers..... 114A
Solvent degreaser leaves no residue..... 114B
Ion-exchange resin allows high flow rates..... 114C
Methyl isoamyl ketone now available..... 114D
Flash-dried starch requires less enzyme..... 114E
Vinyl engraving material resists pressure..... 114F
Epoxy-tar formulation used as electrical insulator..... 114G
Silicone-ceramic coating resists heat, humidity..... 114H

For more details, use Reader Service Card




STOP! STOP THE PRESSES! Caked ink on the cylinders, poor impressions, "fill-in", lost time, wasted money—no wonder, I'm run down and irritable.


What's that? You heard that ESSO has a staff of experts in its refineries continually striving to improve Esso Solvents? You heard that our service is unsurpassed and our terminals conveniently located? Well, you heard exactly right!

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In Industry after Industry..."ESSO RESEARCH works wonders with oil"

Lighter containers for space-age vehicles

Epoxy laminated fiber-glass containers for 3,000-5,000 psi. air or other gases needed in aircraft and missiles are increasing weight savings and are just as rugged as earlier steel spheres.

Choice of fiber-glass impregnated with epoxy resin meets the demand for materials of high strength-to-weight ratio. For this application, Smooth-On prepared a special blend of aromatic amines that when used as hardener in the epoxy bath gave the right combination of toughness and heat resistance to the resin.

Kidde developed the filament-winding process that provides uniform stress distribution: a spherical mandrel of low melting alloy is covered with a rubber liner to minimize gas permeability; then continuous filaments of glass yarn that pass through the resin bath are uniformly wound around the sphere; heat-cure hardens the resin and, upon removal from the oven, the sphere is steam treated to melt the metal mandrel that runs off as it melts. The intact rubber-lined fiber-glass laminate is ready.

These spheres are over 35% lighter than their steel counterparts and perform equally well. They do not shatter under high impact and are impervious to chemical attack.—Smooth-On Mfg. Co., Jersey City, N. J. **114A**

Briefs

Solvent degreaser, SS-25, nontoxic and fire resistant, does not induce moisture into windings of electric motors, leaves no residue, eliminates greases and oils. This degreaser has a dielectric constant of more than 25,000 v., does not produce a flash at the boiling point. — **National Chemsearch Corp., Dallas, Tex.** **114B**

Ion-exchange resin, Duolite C-27, has particle-size distribution designed to allow high flow rates with minimum pressure drop. At flow rates from 5-20 gpm./cu. ft., the operating capacity is 10% greater than other resins give. Beads also provide increased resistance to physical breakdown.—**Chemical Progress Co., Redwood City, Calif.** **114C**

Methyl isoamyl ketone is now commercially available at 17.5 ¢/lb. in tank car lots. Considered the most economical, high-boiling solvent (145 C.) for vinyl and nitrocellulose lacquers, it contributes lower viscosities, has a high relative evaporation rate and offers excellent blush resistance.—**Union Carbide Chemicals Co., Div. of Union Carbide Corp., New York, N. Y.** **114D**

Flash-dried starch, produced in dustless and high-density granules, has been developed for the paper industry. The new coating and sizing starch, labeled Easy-Enz 3387, wets out quickly and is said to convert completely with less enzyme. Higher density makes it possible to store 10% more starch in the same space.—**Corn Products Co., New York, N. Y.** **114E**

Vinyl engraving material, Koroseal 60, won't distort under printing pressures as rubber does. The new material prints bags of all types, including multiwall, fabric and burlap. Koroseal plates possess 50% more life expectancy than other flexible plate materials, provide good ink coverage and do not contain ingredients that bleed or migrate when used with glycol or oil-based inks.—**B. F. Goodrich Co., Akron, Ohio.** **114F**

Electrical insulating qualities result from combining epoxy resins with coal-tar derivatives. Identified as Epocast H-1338, this new low-density product can be used for impregnating and encapsulating of class A insulation of transformers, terminal boards and miscellaneous electrical components.—**Furane Plastics Inc., Los Angeles, Calif.** **114G**

Silicone-ceramic heat-resistant coatings provide protection at all temperatures up to 1,400 F. and withstand the most corrosive environments. Also available are coatings for services that may require sudden chilling from several hundred degrees to the freezing point. Coatings come in various colors, are water repellent, fast drying and have unlimited shelf life because of their nonsettling compositions.—**The Dampney Co., Hyde Park, Mass.** **114H**

For More Information

about any item in this department, circle its code number on the

Reader Service

Postcard (p 269)

ADDED SAFETY is an important benefit when you equip your loading rack with the only gear-driven swivel joint on the market. No danger of the operator slipping on wet or icy decking while pulling down a loading arm. No chance of arm dropping or rising unexpectedly to spill hot or caustic products. No counterbalance arms, cables or pulleys to endanger clearance on the platform. The entire loading operation is constantly controlled by this easy-to-crank joint.

TROUBLE-FREE SERVICE offers an equally important advantage. This gear-driven swivel joint incorporates all the proven features of C-E's popular US-Type Joint. It breaks like a union for quick, easy repairs on location without special tools. No need to disturb bearings when repacking. Wide-spaced bearings and non-split races last longer and permit greater foot/pound loading. Separate races can be reversed easily to double their life.

C-E Gear-Driven Swivel Joints are available in 2, 2½, 3 and 4 inch sizes — styles 3, 4, 5 and 6 — in mild steel or with stainless steel wettable parts.

For more years of service, less maintenance expense and a safer loading rack, equip it entirely with Continental-Emsco's Gear-Driven Swivel Joints. There's a size and type to meet every requirement.

Write, call or wire for the full catalog and price information.

CONTINENTAL-EMSCO COMPANY
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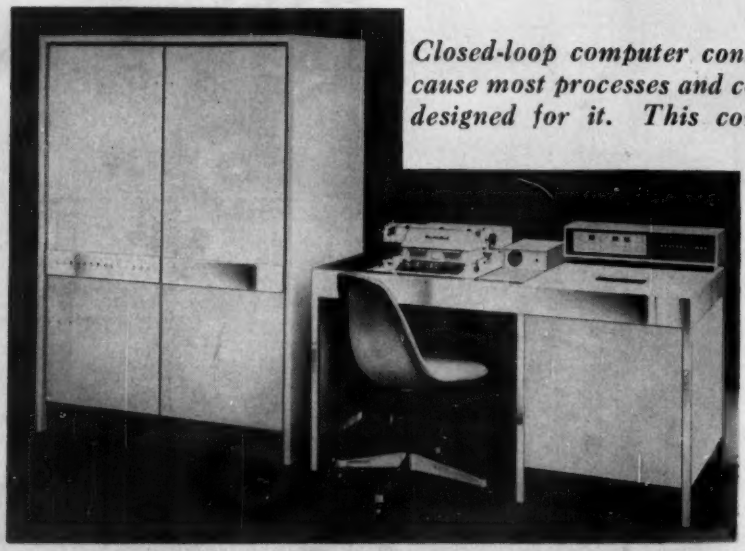


Closed-loop computer control is difficult because most processes and computers were not designed for it. This computer system is.

Libratrol-1000 is packaged for industrial environment, has its own atmosphere.

A STEP CLOSER TO AUTOMATIC CONTROL

Application of computer control to industrial processes may be simplified by the Libratrol-1000, a digital computer system designed especially for closed-loop automatic control.

Previous efforts for the most part were hampered because the computers were originally intended for different service. Other factors which hamstrung the development of computer control:

- Many processes were developed before modern computers were available.
- Many existing industrial installations were not built for computerized control.

With these factors in mind, Libratrol-1000's designers planned a computer control system that could dovetail with the present stage of industrial development. It is equally capable of taking over new processes developed for computers.

Completely transistorized, the Libratol-1000 includes an advanced memory unit, new developments in read-and-write-head-design and a built-in voltage-to-digital converter.

▶Takes Over Gradually—The new computer is said to be capable of gradually taking over an existing process. It can:

- Accept inputs from available process instruments.
- Provide outputs suitable for the operation of existing equipment and control devices.
- Analyze (with personnel guidance) the nature of process operations and their response to control actions in order to formulate effective on-line control criteria.
- Take complete control of the process by gradual steps without disturbing the existing production rate.

▶How It Works—Like all computers, Libratrol-1000 can act only on the information it is given. Whatever the nature of signals emanating from mechanical or electrical instruments, standard industrial transducers can convert them into suitable voltages for computer input.

These voltages pass through a digital converter whose output, presented as ten binary bits plus sign, is entered on a 64-word buffer track on the computer memory drum. The buffer section serves as a sort of temporary memory from which information may be used immediately or transferred to the main memory section.

The machine proper is a transistorized, two-address, serial-binary

The new unit, shown being given its final check, uses 43 different commands.

THERE IS A DIFFERENCE IN PIPE FITTINGS

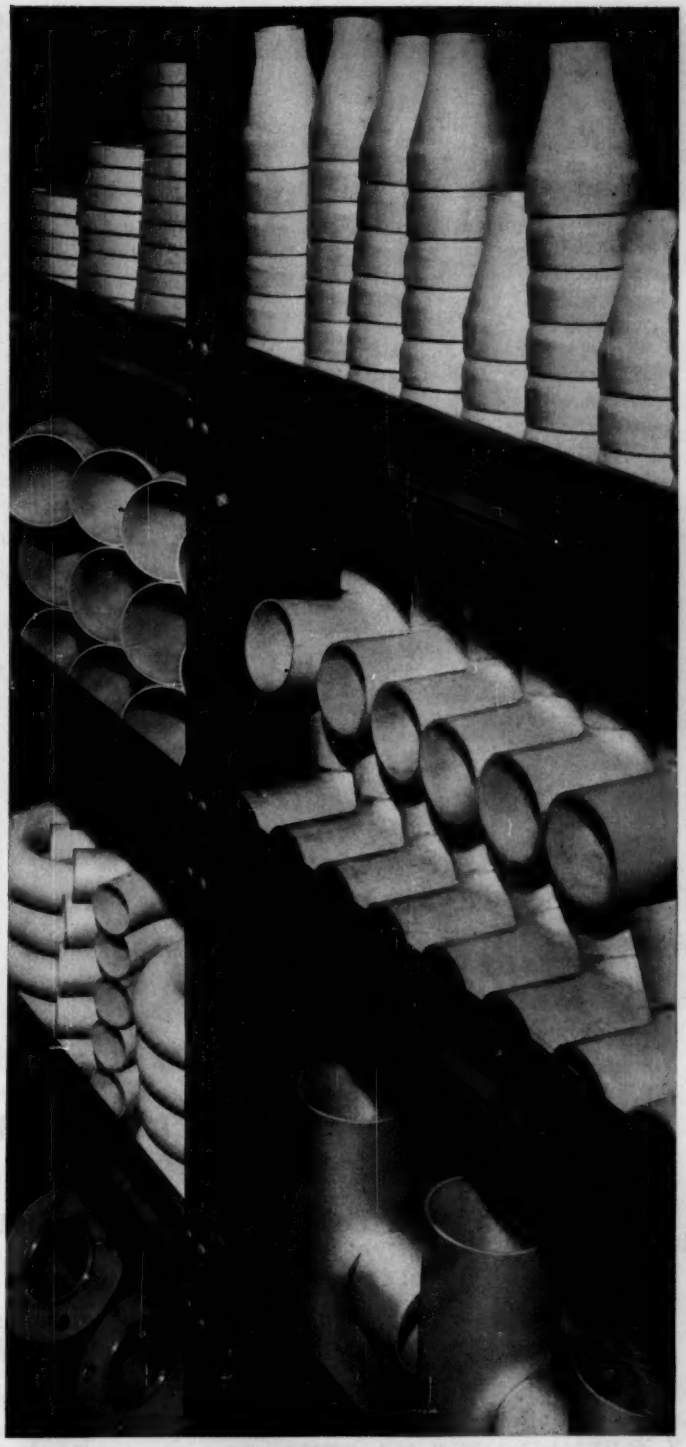
Speedline®

FITTINGS ARE IN STOCK NOW... COAST TO COAST

It's one thing to catalog a complete line of long-tangent fittings . . . it's another to have them ready to ship to your plant—*when* you need them. Speedline engineering and manufacturing experience has "standardized" production on even the most specialized fittings . . . including eccentric reducers, reducing tees and crosses . . . making it possible to maintain extensive inventories both at the factory *and* in the field.

A Speedline distributor is prepared to give delivery-from-stock on stainless steel fittings . . . including Carpenter 20 . . . for every process piping requirement. He can also assure prompt service on Speedline fittings in aluminum, titanium, zirconium, Hastelloy and other special corrosion-resistant alloys.

Leading plants have proved there *is* a measurable difference with Speedline fittings . . . the only complete line of long-tangent fittings available from distributor stocks. Let a Speedline distributor prove the difference Speedline experience and ready availability can make at your plant.



1003

Speedline®

CORROSION-RESISTANT FITTINGS

A PRODUCT OF HORACE T. POTTS COMPANY • 500 E. ERIE AVENUE, PHILADELPHIA 34, PA.

digital computer containing an 8,000-word magnetic drum for a working memory. Computer word length is 31 bits plus a sign bit.

▶**Word Length Significant**—Long word length makes it possible to include the coded instruction, the operand address and the address of the next instruction in a single word space. Search time is quick—an average of 2,000-3,000 words/sec. is obtainable under optimum programming.

Control outputs of the L-1000 consist of contact closures or control voltages. Both types, converted by suitable actuating hardware, can furnish required control actions such as setting switches or turning valves.

▶**Two-Step Conversion** — The L-1000 is incorporated into an industrial process in two phases. First, it receives input data from process instrumentation, computes and records set points, and displays information for the operator's guidance for manual control.

When enough knowledge of control problems has been developed to permit effective programming, the computer can be directed to automatically control the process.

As a unit, the new system is designed to withstand environmental extremes. The main computer console is protected with a self-contained atmosphere, impervious to humidity and corrosive fumes. A refrigeration unit assures optimum operating temperature. The control console, which can be located remotely from the main computer cabinet, is also protected against dirt, humidity and corrosive fumes. — **General Precision Inc., Librascope Div., Glendale, Calif.** 116A

S.S. Martha Mac anchors in mid-Mississippi, unloads cargo from one side, simultaneously takes on outgoing bulk material on the other side.

NEW VESSEL DOCKS ANYWHERE

Modern materials-handling system on bulk cargo ship makes it independent of port facilities.

A new kind of bulk cargo vessel, which might be called the "S.S. Ambideckstrous," can simultaneously load or unload from both sides without the aid of port or dock facilities.

First ship of its type, the S.S. Martha Mac can discharge or pick up materials at a rate of 2,800 tons/hr. from or to other vessels or shore storage piles. Her unique material handling system makes this possible.

Material handling equipment includes a closed-circuit, 54-in. conveyor system circling the top deck, two traveling track hoppers with belt feeders, two traveling swinging tripper-boom stackers fitted with telescoping delivery chutes, and two revolving electric cranes with 9½-cu. yd. clamshell buckets.

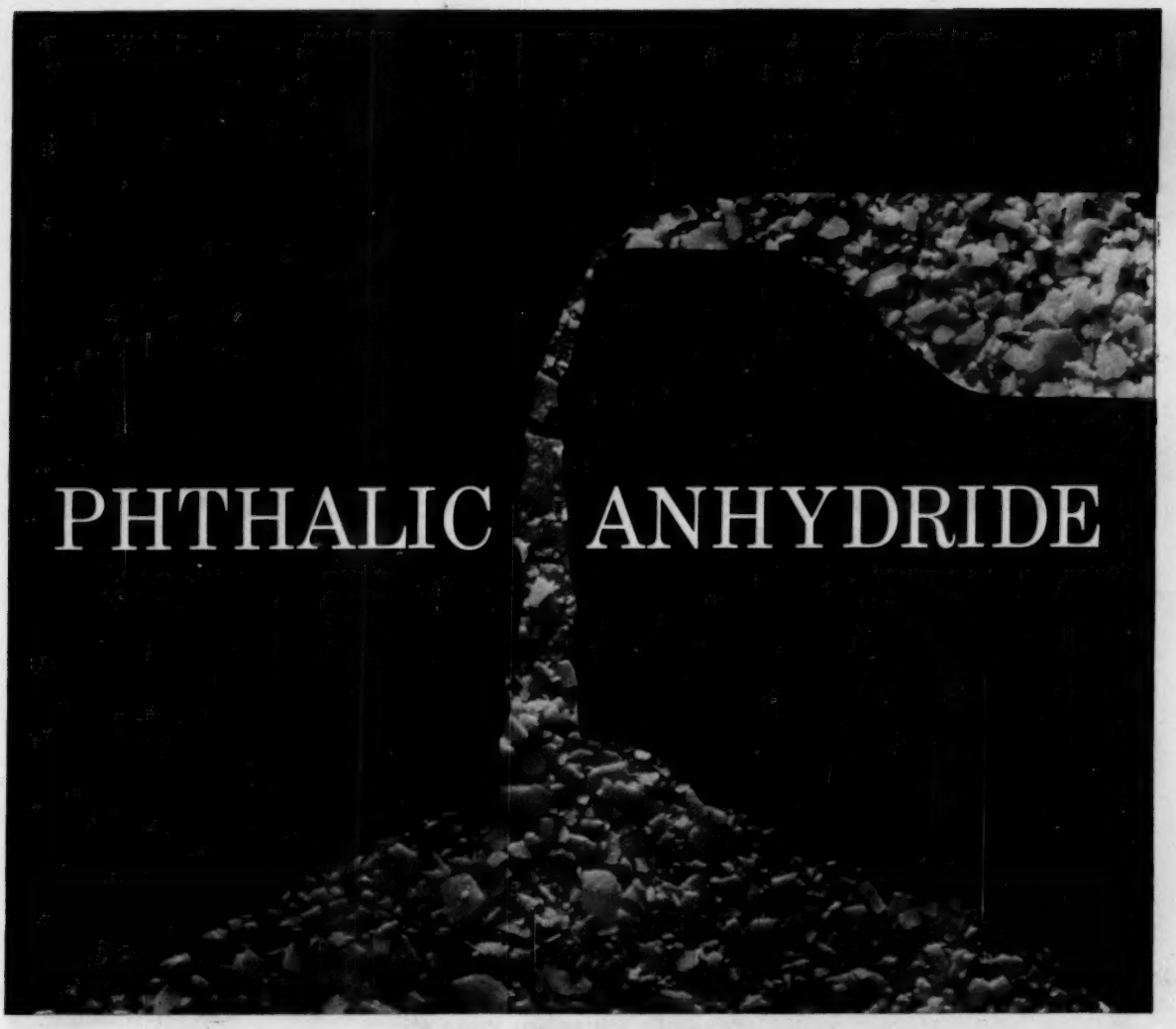
Loading and unloading follows a definite sequence. Material is picked up by the buckets, dumped into the track hoppers. These feed the conveyor system which, in turn, feeds the stackers that are outrigged for discharging into barges or shore-based stockpiles. The stackers are also swung inboard, to deliver material to one of four cargo holds.

While the Martha Mac is loading or unloading barges or other vessels, the delivery chutes on the stackers can be adjusted to compensate for the various height changes between the vessels, thus preventing spillage or, during windy weather, dusting.

Formerly an oil tanker, the Martha Mac now hauls phosphate from Florida to the lower end of the Mississippi, where she unloads it into barges for the trip upriver. She then takes on a cargo of coal and other bulk materials, which have been barged down the river, for delivery to Gulf ports.

While larger self-unloading systems have been built for bulk cargo vessels (6,000 tons/hr. is not unusual), the Martha Mac is unique in being able to both load and unload without shore help.— **Hewitt-Robins, Inc., Stamford, Conn.** 118A

More New Equipment on page 120



Foster Wheeler plants...in these countries:
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Foster Wheeler exported its first complete phthalic anhydride plant in 1947.

For 19 years FW has designed and fabricated major equipment for phthalic anhydride plants.

Common to all Foster Wheeler plants is *simplicity* . . . of start-up and operation.

All are tailored to particular commercial and technical requirements for:

- first cost
- feed stock
- yield
- product purity
- operating cost
- plant availability

For information, write to Foster Wheeler Corporation, 666 Fifth Avenue, New York 19, N.Y.

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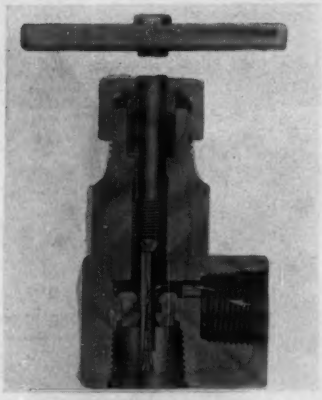
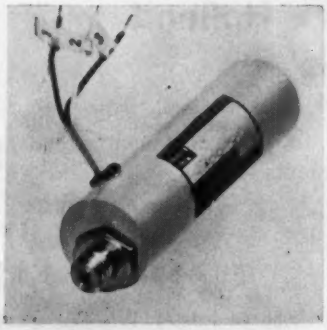


Controlled-flow valve

Drops/hr. or gpm.; close throughput control is major feature.

This versatile new valve is designed to give flow control in the range from drops/hr. to 5 gpm. At 5,000 psi., it can be deliver as little as 3 cc./min.; at lower pressures accurate control is possible at 10 drops/hr. Maximum operating pressure is 10,000 psi.

All flow passes through a variable triangle-shaped orifice sealed with Teflon, synthetic rubber or stainless steel. Standard construction materials: carbon or stainless steel, bronze. Valves start at $42.50.—**General American Valve Co., Corona del Mar, Calif. 120A**

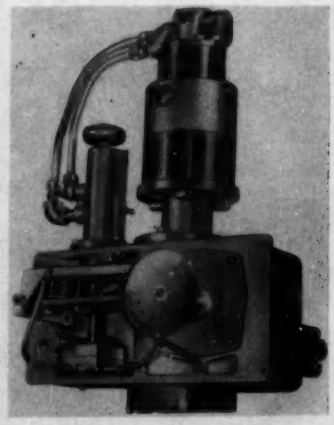


Tiny transducer

Good to 15,000 psi., 600 F., it weighs less than ¼-lb.

Half as small as previous devices, a new line of high-temperature pressure transducers is capable of measuring up to 15,000 psi. The units measure gage, absolute or differential pressure at temperatures to 600 F.

Pressure-sensing element of Series 8416 transducers is a twisted tube that moves a wiper across the winding of a precision potentiometer in response to changes in pressure. The elements are enclosed in a case that has suitable pressure ports and electrical terminals.—**Colvin Laboratories, E. Orange, N. J. 120B**



Pump controller

Pneumatic unit adjusts stroke of chemical metering pump.

If flow rate adjustments are needed on a reciprocating metering pump, a pneumatic controller will do it automatically. New unit alters pump's stroke length to give varying flow rates of metered liquid.

Designed to fit the manufacturer's line of metering pumps, the controller bolts on the pump in place of the normal adjusting handle. (In case air supply is lost, the pump can be controlled manually with a shaft on the controller housing.)

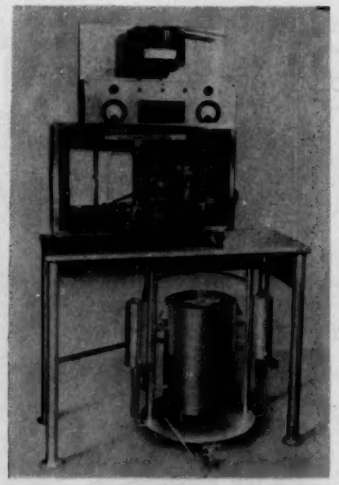
The controller accepts linear, square root or other exponential signals. It is sealed to protect it from environment. — **Wallace & Tiernan, Inc., Belleville, N. J. 120C**

For More Information

about any item in this department, circle its code number on the

Reader Service Postcard

(p. 269)



Thermo-balance

Weight-change of sample recorded during heating cycle.

The answer to "What happens when you heat it"? may be found in a new thermo-gravimetric balance called the Thermo-Balance. Originally designed for recording the degasification of solid fuels, it is now available for all testing where increase or decrease in the weight of various materials, subjected to continuously increasing temperatures, is wanted.

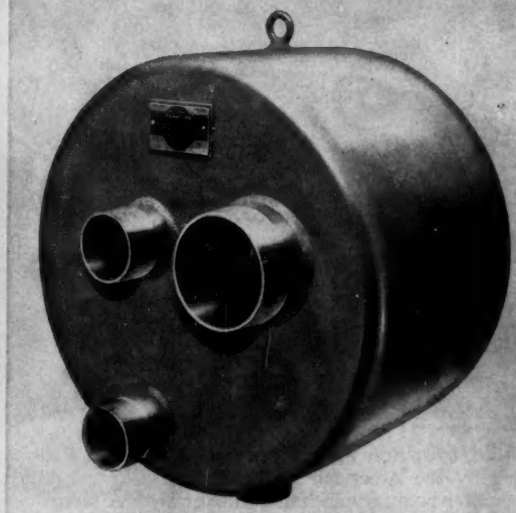
Three main parts comprise the instrument. It has a low-voltage tube furnace, a control panel and a magnetically damped balance. Sensitivity of the balance on the recording chart is 175 mm. for a 1-gr. weight loss. The unit operates on 220-v. a.c. power.—**C. W. Brabender Instruments, Inc., So. Hackensack, N. J. 120D**

Equipment News
Continues on page 238

ARE YOU LOOKING

for a NEW HEAT EXCHANGER that offers

1. LOW FIRST COST
2. HIGH PERFORMANCE
3. COMPACTNESS
4. TROUBLE-FREE OPERATION
5. FREE OF THERMAL STRESSES
6. READILY AVAILABLE



The NEW PANAFLOW Heat Exchanger

The Heliflow Corporation (an affiliate of Graham Manufacturing Co., Inc.) has developed PANAFLOW after years of research to provide industry with a low cost unit that still embodies most of the advantages provided for in a standard Heliflow Heat Exchanger.

If you are looking for the heat transfer equipment described above, don't overlook PANAFLOW.

Consult our factory-trained personnel in any of the following cities. They will be pleased to show you how PANAFLOW can be adapted to your heat transfer problems.

Heliflow Corporation

170 GREAT NECK ROAD • GREAT NECK, NEW YORK

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NEVER BEFORE

A GOGGLE THAT PROTECTED SO MUCH, SO WELL!

AO 711

SPLASH & RADIANT HEAT

GOGGLE

Forehead, eyes, nose and part of the lower face are all protected by the American Optical new "711" goggle against molten sodium splash and radiant heat. A prominent chemical company saw the need for this goggle, and we developed it together. Particularly noteworthy is the plastic extension which provides protection over part of the forehead . . . and the built-in plastic hook over the nose section. When additional face and neck protection is needed, the hook can hold a fireproof drape between worker and hazard. The goggle has no vents, yet the indirect ventilation is ample and the lens of .050" thick plastic has double the fog resistance of conventional goggles of this type. Soft vinylite mask for comfort . . . wide angle vision for safety and efficiency.

GUARANTEED LIQUID-PROOF!

Here's a big handful (14½" long) of "sure footed" hand protection. It's pure neoprene — no plastic added. The absence of a seam across the thumb crotch eliminates a weakness usually found. 8 oz. canton flannel lining (not cotton sheeting). Has many applications — handling acids, caustics, kerosene, oil and solvents, etc. The 781 is one of 7 different styles.

AO 781
Neoprene Glove

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U.S.I. CHEMICAL NEWS

September ★ A Series for Chemists and Executives of the Solvents and Chemical Consuming Industries ★ 1960

Coal Tar Naphthalene Is Purified Economically by Continuous Sodium Process

A semi-continuous, commercial process for desulfurizing coal tar naphthalene, through treatment with metallic sodium, has been developed by U.S.I. specialists in sodium chemistry. This development provides coke oven producers with an efficient and economical method for purifying naphthalene to the levels demanded by makers of phthalic anhydride, dyes, vinyl plastics, moth balls and other naphthalene products.

78° Naphthalene can be treated with 1.5% by weight of sodium for reduction of sulfur content from about 0.5% to less than 0.05%, at a cost of under one half a cent per pound. Naphthalene recovery would exceed 99%. Capital investment for a plant to treat 50-60 million lb./yr. of naphthalene would be about $50,000.

In such a semi-continuous plant naphthalene—with residual phenols removed through pretreatment with solid caustic for best sodium efficiency—is fed into a series of kettles and contacted with sodium for 30-60 minutes. The naphthalene is then flash distilled from the residue. The residue, upon decomposition with steam, yields crude napthalene, low in sulfur, which would be returned to the head of the process.

Bulk sodium is metered directly into the treating kettles. With adequate agitation, sodium will emulsify quickly and

MORE

New Trona Mining Method Planned in Intermountain's Soda Ash Plant Expansion

Intermountain Chemical Co., a 10% owned affiliate of U.S.I., has announced plans for a $4,000,000 expansion of their soda ash facilities, to be completed in 1962. Capacity is being increased from 520,000 to 720,000 tons per year.

The company mines trona ore in the Green River area of southwestern Wyoming and refines the ore into soda ash. A new method for mining trona, developed by Intermountain, will be tried for the first time as part of the expansion. It is a continuous system for mining, extraction and movement of trona which eliminates blasting and drilling underground. The method uses augers, adapted from hard-coal mining.

During expansion, Intermountain will also make changes in refinery technology.

Final Regulations on Tax-Free And SD Alcohols Now in Effect

A&TTD Issues New Simplified & Liberalized "User" Regulations

The Alcohol and Tobacco Tax Division of Internal Revenue published final revised regulations (effective July 1) on the distribution and use of Specially Denatured and Tax-Free Alcohols in the Federal Register of June 29. These regulations provide for administration of the Internal Revenue Code of 1954 as amended by the Excise Tax Technical Changes Act of 1958.

For the first time, the A&TTD has separated "user" regulations from others covering production of ethyl alcohol and specially denatured formulations. Here is a brief summary of some of the important provisions of the new "user" regulations. For details, see Industry Circulars 60-22 on SDA and 60-21 on Tax-Free.

(1) **Industrial Use Permits**—Forms 1481 (SDA) and 1447 (Tax-Free)—no longer have to be renewed annually. They remain in effect unless suspended, revoked, surrendered or otherwise terminated.

(2) **Withdrawal Permits:**
Form 1485 (SDA)—permits expire Oct. 31 each year. Renewal application must be filed annually by July 10. Effective Nov. 1, 1961, permits will allow monthly withdrawal of 1/6 of annual allowance (formerly 1/12).
Form 1450 (Tax-Free)—permits expire Apr. 30 each year. Renewal application must be filed annually by Jan. 10. Effective May 1, 1961 (earlier with special permission), permits will allow monthly withdrawal of 1/6 of annual allowance (formerly 1/12).

(3) **Losses**—on SDA, the minimum quantity on which a claim for re-

MORE

New Polyethylene Bag with No-Leak Closure Shows Promise as Sterile Pack

A new, low-cost, sterile polyethylene bag with a wire tape closure is now being used by the dairy industry for milk sampling and reportedly finding application in a number of fields, including cosmetics. The containers are made of clear, heavy polyethylene tubing, sealed both top and bottom to keep the inside sterile.

A line of perforations is provided for removing the sealed top. Below the perforations are two wire tapes which help in opening and form the closure for the bag. For resealing, tapes are pulled taut, top of bag is rolled down, and projecting ends of tapes are bent over. A liquid-tight closure is formed. The three photos below show unsealing, opening and resealing.

New polyethylene bag is sterile-sealed until perforated top is zipped off.

Bag is snapped open by pressing in on wire tapes around top opening.

Liquid-tight resealing is done by rolling bag top down, and folding tape ends over.

CONTINUED *Alcohols*

mission of tax must be filed has been increased to 5 wine gallons. On Tax-Free, the minimum quantity has been increased to 5 proof gallons.

(4) **Reports:**
Form 1482 (SDA)—submitted annually instead of monthly for users who withdraw less than 660 gal./yr. Those who withdraw more must still report monthly, unless otherwise authorized.
Form 1451 (Tax-Free)—submitted annually instead of monthly.

(5) **Samples**—SDA samples of one quart may be obtained without permit.

(6) **Samples of Labels and Advertising** for articles not containing SDA, but made from SDA, no longer required by A&TTD except on request.

(7) **Carrier Permits**—no longer required.

(8) **Proprietary Solvents**—may be packaged by *distributors and users* as well as manufacturers, provided the packages are properly marked.

(9) **Return**—Consent of Surety for return will no longer be required of SDA permittees, but will be required in blanket form from person to whom returned.

Many other points are also covered in detail in Industry Circulars 60-22 and 60-21. It can be seen that the A&TTD has made the new regulations more liberal, and has simplified the paper work involved in the use of SDA and Tax-Free Alcohols.

CONTINUED *Naphthalene*

react. It is not necessary to use predispersed sodium, since crude naphthalene contains many naturally occurring trace impurities which are excellent dispersing aids for sodium.

For further information, send for the new U.S.I. technical data bulletin "Desulfurization of Naphthalene by Sodium". Address Technical Literature Dept., U.S.I. Chemical News, 99 Park Ave., N.Y. 16, N.Y.

New Polyethylene Resins Produce Squeeze Bottles Of Excellent Appearance

U.S.I. has developed three new PETROTHENE® polyethylene resins with properties particularly suited to the blow molding of bottles for drugs, cosmetics and chemical specialties. Two of the resins can also be used for injection molding. All have been successfully field tested. Each of the resins produces bottles of outstanding appearance, good stress crack resistance and excellent low temperature flexibility.

PETROTHENE 101 and PETROTHENE 102-2 can be used in both blow molding and injection molding. The first has high stiffness, which permits reduction in wall thickness and, consequently, lower cost per container. The second has high impermeability to liquids, oils and gases, and a high flow rate which is particularly useful in blow molding pieces 6 to 20 oz. or heavier. PETROTHENE 209-2 is designed for use only in blow molding, especially for relatively small moldings—under 10 oz. —with thick side walls.

Data sheets on these three new resins are available from U.S.I. Address Technical Literature Dept., U.S.I. Chemical News, 99 Park Ave., New York 16, N. Y.

First heat exchanger successfully fabricated from zirconium is part of unit to concentrate H_2O_2 solutions. Zirconium's corrosion resistance in this application made it profitable to overcome welding problems associated with the metal. (Photo courtesy The Pfaudler Co.)

TECHNICAL DEVELOPMENTS

Information about manufacturers of these items may be obtained by writing U.S.I.

High molecular weight synthetic polypeptides now commercially available include glutamic acid, γ-benzyl glutamate, lysine hydrobromide, ε-carbobenzoxylysine, o-carbobenzoxytyrosine, leucine, alanine, phenylalanine, tyrocine. **No. 1630**

New booklet on industrial hazards—casualty, fire, pollution and product liability—discusses measurement, detection, correction and litigation. Stresses prevention, and need for help of experts when mishaps occur. **No. 1631**

Borax and other boron compounds are described in new brochure which can now be obtained. Contents include historical data; production, uses, properties of commercial boron compounds; properties of 28 research chemicals. **No. 1632**

Kit for emergency radioactivity decontamination is now on market. Provides radioisotope users and laboratories with respirator, disposable clothing, decontamination solutions, instruction manual—all in steel case. **No. 1633**

Acetone specifications, properties, shipping methods and uses are listed in new data sheet now available. Material is widely used as solvent, and in making drugs, dyes, plastics and many other organics. **No. 1634**

New polyethylene drum faucet is said to empty 55-gallon drum of average material in about two minutes. Fits standard 2-inch drum outlet. Comes with polyethylene spout closure to eliminate residual dripping. **No. 1635**

Hair care is covered in new book now being sold. Said to be most complete ever written for layman on growth, care, diseases and treatment of hair disorders. **No. 1636**

Non-electric magnets have been installed under belts of conveyors on aerosol filling lines to hold cans in place during underwater travel to heating bath. Magnetic units said to be available in lengths to fit any conveyor belt. **No. 1637**

The rare earths plus thorium, scandium and yttrium—chemicals, metals, alloys—are detailed in new booklet. Gives uses, potentials, production, properties, chemical analyses for over 50 products. **No. 1638**

New, versatile, bench model superspeed centrifuge with built-in safety shield, accommodating 5 interchangeable rotors for batch or continuous flow separations, is on market. Rotors are fitted with removable polyethylene liners. **No. 1639**

PRODUCTS OF U.S.I.

Ethyl Alcohol: Pure and all denatured formulas; Anhydrous and Regular Proprietary Denatured Alcohol Solvents SOLOX®, FILMEX®, ANSOL®M, ANSOL PR

Organic Solvents and Intermediates: Normal Butyl Alcohol, Amyl Alcohol, Fusel Oil, Ethyl Acetate, Normal Butyl Acetate, Diethyl Carbonate, DIATOL®, Diethyl Oxalate, Ethyl Ether, Acetone, Acetoacetanilide, Acetoacet-Ortho-Chloranilide, Acetoacet-Ortho-Toluidide, Ethyl Acetoacetate, Ethyl Benzoylacetate, Ethyl Chloroformate, Ethylene, Ethyl Sodium Oxalacetate, Sodium Ethylate, Urethan U.S.P. (Ethyl Carbamate), Riboflavin U.S.P.

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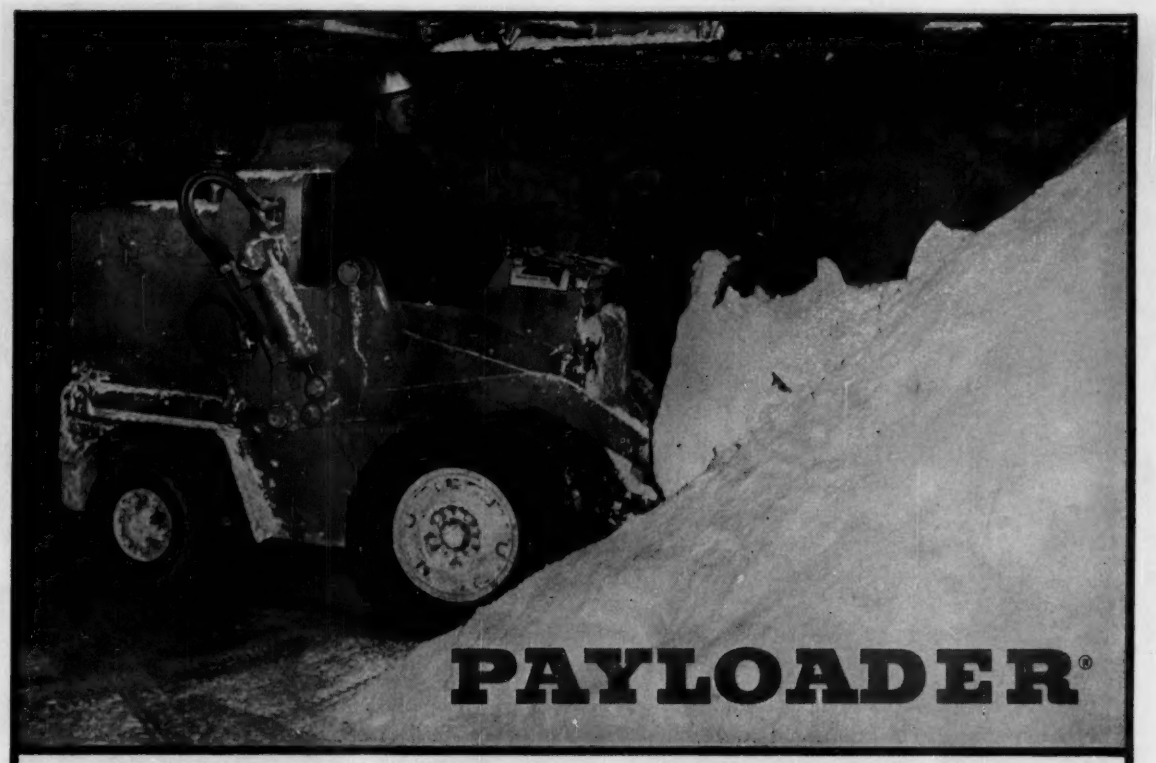

What users say about the H-25..

The success of the H-25 "PAYLOADER" can best be gauged by what owners and operators of this tractor-shovel say about it. Here are typical comments from users in foundry, chemical, ceramic, paper, and other industries.

Power and Capacity: "Gives nearly twice the production of our old HA's . . . good digging power and traction, fast lifting power. The most efficient we've ever used — outperforming larger loaders." "Before purchasing the H-25 we had competitive demonstrations that proved its production efficiency over other machines."

Speed and Maneuverability: "Is quicker on the lift, dump and go than the . . . . . — is more compact . . . gets into smaller places easier and faster." "Is doing a top production job. Power-steer and power-shift combination gives us maximum efficiency from both the machine and the operator."

Easy Operation: "The H-25 is a dandy with its power-steer and power-shift — gets full loads without spinning wheels and the operator lasts longer too." "I like the maneuverability and work capacity."

Reliable: "We find they stand up under tough rugged duty with minimum repairs." "The low maintenance on the H-25's has been way superior to any loader previously used. It's a real producer, easy to service." "Gives maximum production output under ideal *or* adverse conditions."

The satisfaction being delivered by the 2500-lb. capacity model H-25 is a reflection of the kind of performance built into *all* "PAYLOADER" units. There are 20 models in 8 capacity ranges — up to 12,000 lbs. operating capacity — to meet your needs, and a nearby HOUGH Distributor to serve you. He has the finest parts and service facilities, backed by factory service personnel to keep your "PAYLOADER" investment profitable.

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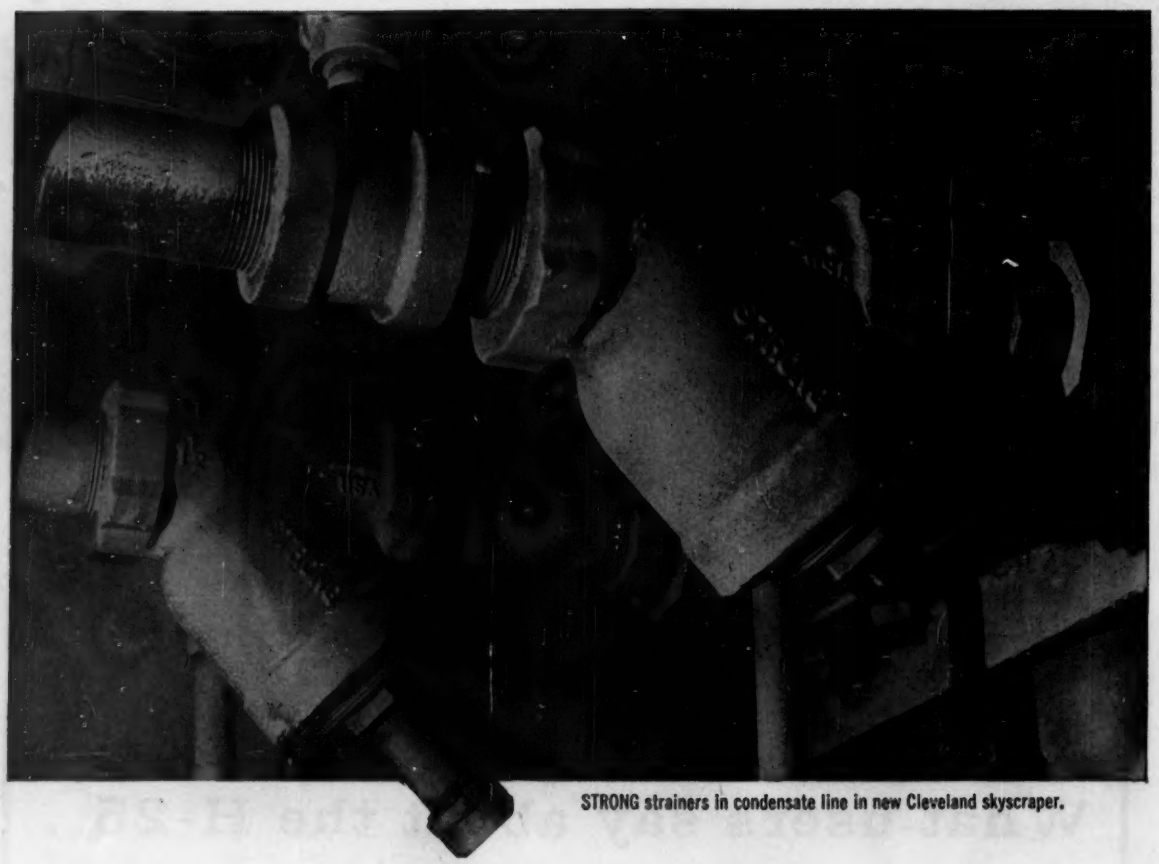


STRONG strainers in condensate line in new Cleveland skyscraper.

select the STRONG® strainer *designed for you!*

IN steam, air, gas, water, oil or chemical systems, a *correctly selected* strainer pays for itself many times. It protects expensive equipment (traps, control instruments, meters, etc.) and reduces over-all maintenance and service costs.

Assure your system maximum protection from dirt, scale, sludge and sediment . . . specify *the* STRONG strainer designed for your requirements.

Sizes: from ¼" to 8"

Service: 250 psi at 450° F to 2500 psi at 1100° F

Screens: stainless screens with .027", .045", .062", or .125" perforations (at no extra cost)

Types: "Y" or Angle with screwed or socket-weld (flanged) connections

Materials: semi-steel, ductile-iron, bronze, Monel, cast or block steel, or new all-stainless or Hasteloy

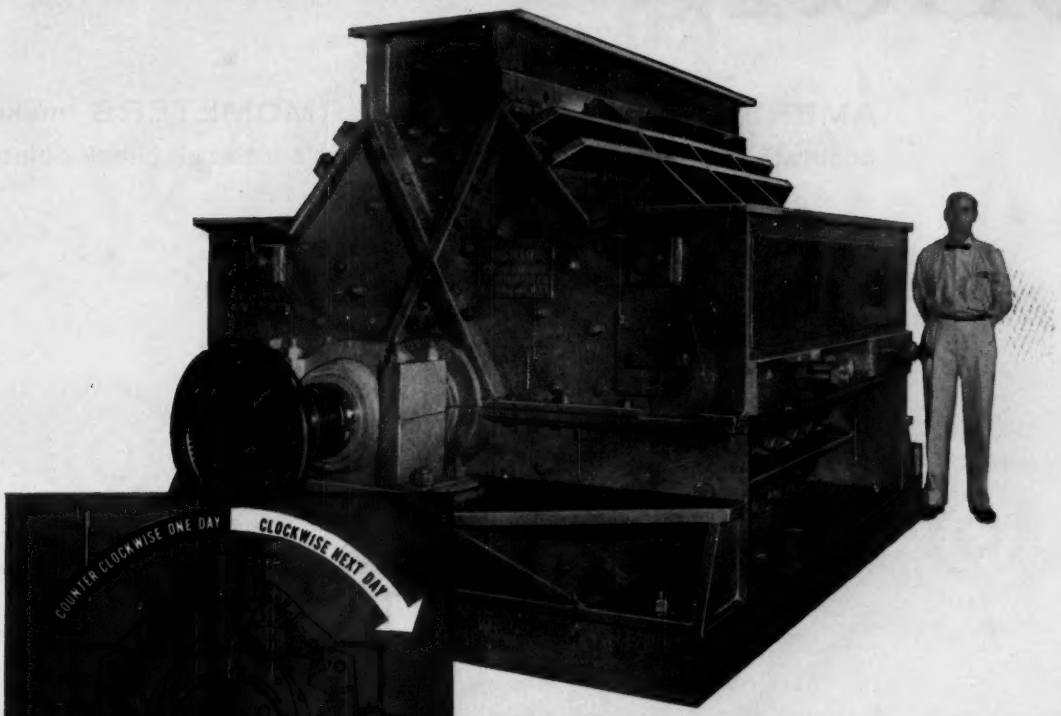
STRONG'S extensive line of rugged, high-quality strainers are available from your local STRONG distributor. Contact him for assistance in selecting the *right* strainer, or write for your copy of STRONG Bulletin SS—21C.

STRONG, CARLISLE & HAMMOND

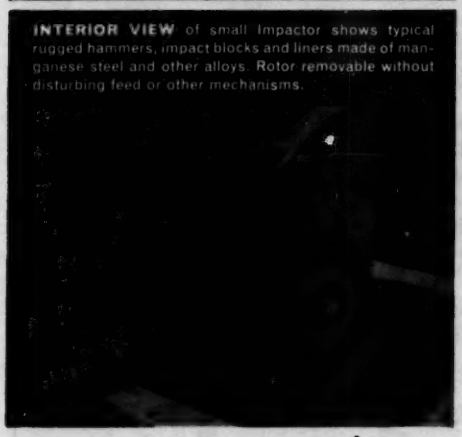
508 Sandusky Street, Conneaut, Ohio

air traps • strainers • reducing valves • vacuum or pumping traps
continuous blowdown valves • separators • engine stops • F and T traps • safety headgear

More efficient CRUSHING AT LOWEST COST for labor, power and upkeep with WILLIAMS REVERSIBLE IMPACTOR



REVERSIBLE ROTATION prolongs parts life without manual adjustment. A simple reversing switch on motor does it.



INTERIOR VIEW of small Impactor shows typical rugged hammers, impact blocks and liners made of manganese steel and other alloys. Rotor removable without disturbing feed or other mechanisms.

For secondary crushing, the economy and high production of a Williams Reversible Impactor is unequalled, whether raw material is hard and abrasive or soft and friable. Precision control of specified top-size is easy, usually in a closed circuit system, from a coarse 2" with minimum fines, down to 35 mesh or finer.

The Impactor has no grates. Material fed into the mill is reduced to proper size while rebounding between the whirling hammers and impact blocks, until discharged from bottom opening. Grinding or rubbing action is eliminated—power, replacement parts and downtime are reduced to a minimum. No fine adjustments need be maintained.

Reversible rotation is a prime feature of the Williams. So is *Wide Open Accessibility* to interior. So are the *Interchangeable Impact Blocks* to balance wear. So are the many other exclusives that hold cost-per-ton to the very lowest. There is a size and model for your exact needs. *Write for catalog.*

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AMERICAN BI-METAL THERMOMETERS make accurate temperature readings sharp and sure at all check points

American Dial Thermometers are also available in mercury, vapor pressure, and gas actuation . . . on-the-spot and distant reading types . . . in sizes, ranges and stem lengths to meet your most exacting requirements.

sensitive

Any way you look at an American Bi-Metal Thermometer, you see exact working temperatures.

The two-level "Maxivision®" dial eliminates parallax effects. Numerals are on the lower level. Graduations are on the outer raised ring dial which presents a sheared edge to the tip of the pointer and in the same plane. To make readability even more accurate, the glass and graduated dial are closely spaced.

American Bi-Metal Thermometers are made of weather-proof stainless steel. All joints are welded to solid unity, then polished smooth so corrosion won't build up and destroy the thermometer's usefulness. And, you don't have to discard this thermometer even if the glass is ever broken. The bayonet lock bezel makes replacement easy.

Learn about the high sustained accuracy and long service life built into American Bi-Metal Thermometers. Phone your nearby industrial supply distributor for help in selecting the right type for each temperature check point in your plant. Or write for Catalog 100A.

MANNING MAXWELL & MOORE INC. M&M TRADE MARK

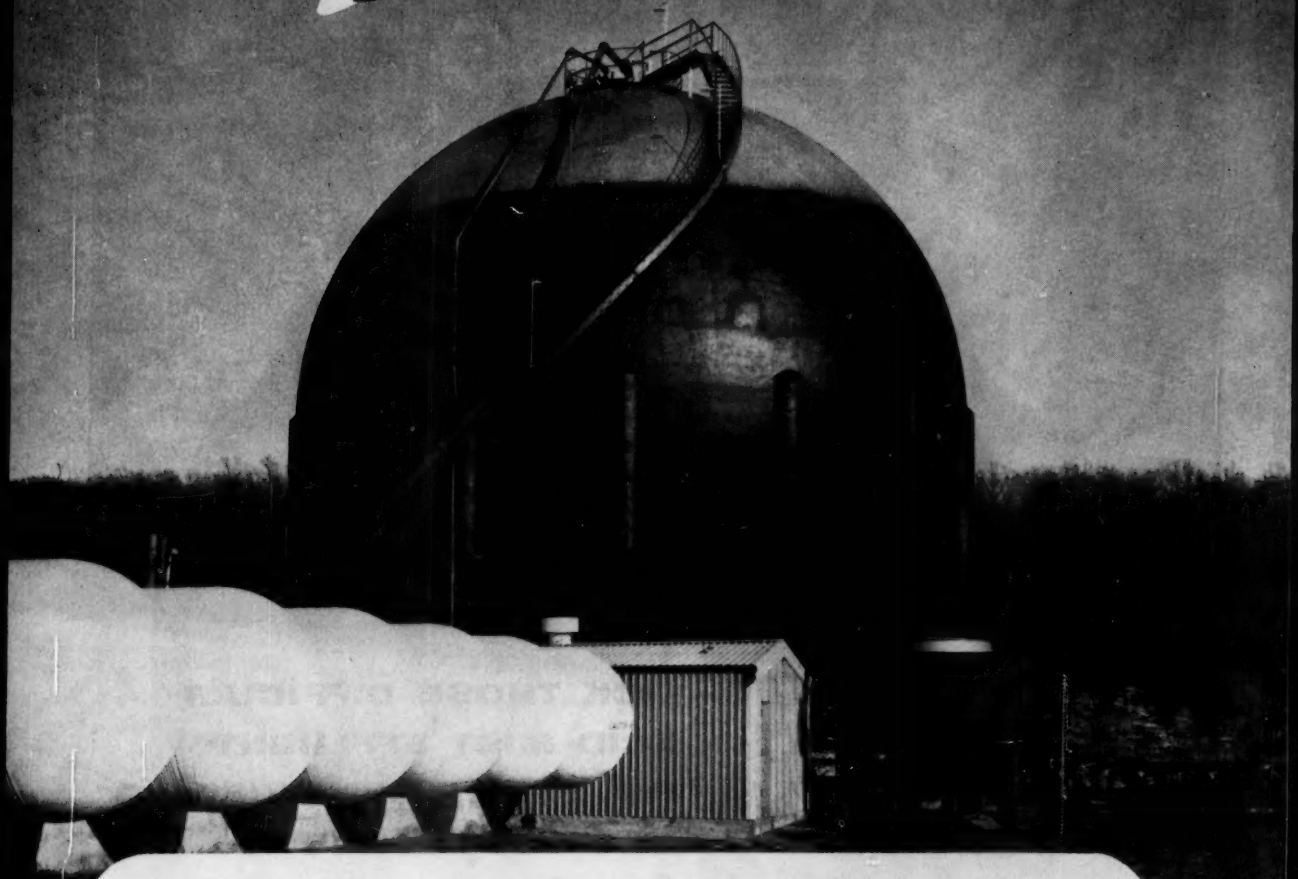
AMERICAN INDUSTRIAL THERMOMETERS

A product of

MANNING, MAXWELL & MOORE, INC.

Gauge and Instrument Division • Stratford, Connecticut
In Canada: Manning, Maxwell & Moore of Canada, Ltd., Galt, Ontario

Another CB&I "Turnkey" Project...



Low Temperature Ammonia Facility

CB&I's ability to handle all phases of design, fabrication and construction of low temperature facilities is highlighted by a "turnkey" installation completed for Mid-South Chemical Corporation at North Pekin, Illinois.

Centered around a 28,000-barrel Hortonsphere®, the Mid-South anhydrous ammonia facility includes piping, controls, refrigerating equipment for incoming product and re-cycling of evaporated gas.

From initial design through start-up of the plant, CB&I had complete responsibility for quality construction and operation of the entire project.

A CB&I specialist will be happy to discuss your requirements on low temperature or cryogenic installations—at no obligation, of course.

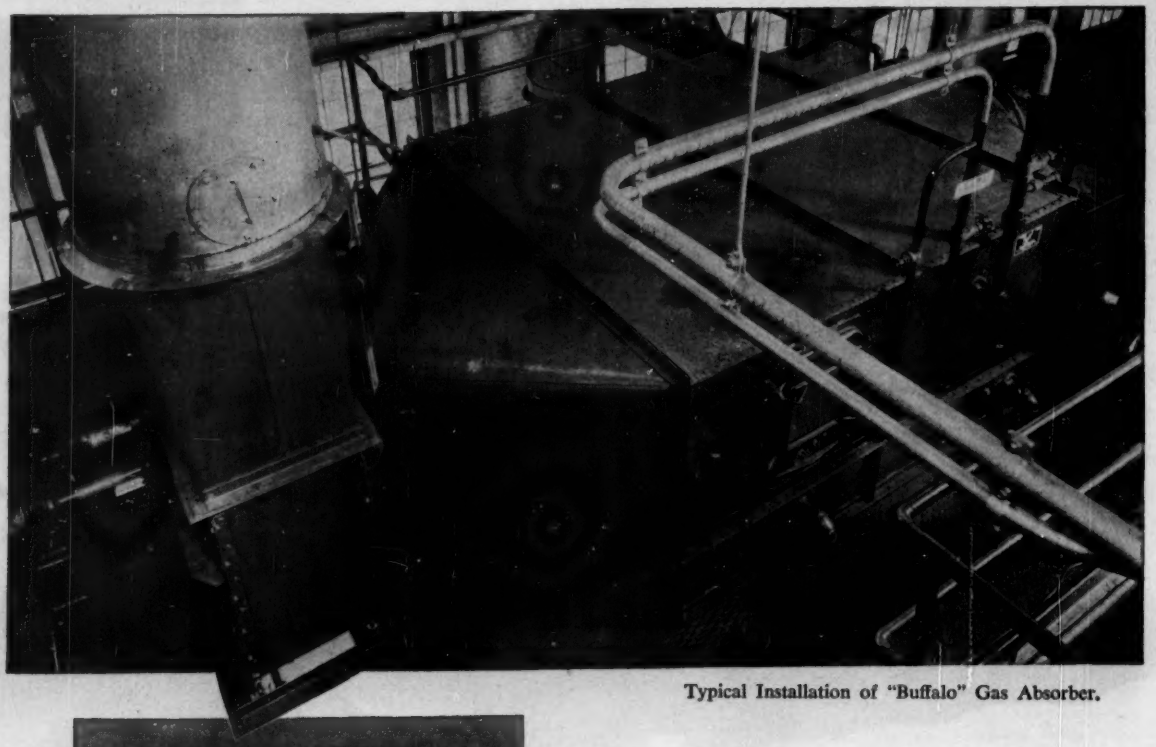
Write for Bulletin G-48—"Refrigerated Storage Facilities".

CHICAGO BRIDGE & IRON COMPANY

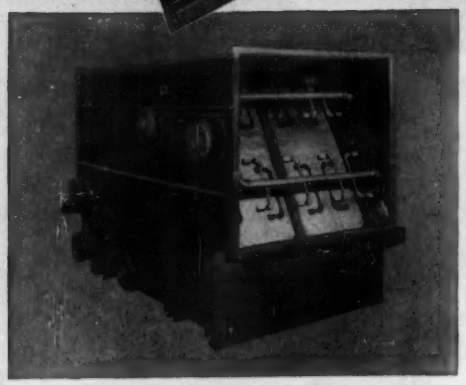
332 SOUTH MICHIGAN AVENUE
CHICAGO 4, ILLINOIS

OFFICES AND SUBSIDIARIES IN PRINCIPAL CITIES THROUGHOUT THE WORLD

C5CB



Typical Installation of "Buffalo" Gas Absorber.



PVC lined gas absorber for handling aqua-regia fumes.

LICK THOSE DIFFICULT ACID MIST EFFLUENT PROBLEMS with 'BUFFALO' GAS ABSORBERS

- **Highly efficient**
- **Low air flow resistance**
- **Minimum maintenance**
- **Easy installation**
- **Low operating cost**
- **Compact and lightweight**

"Buffalo" Gas Absorber washers are extremely efficient air pollution control units capable of collecting acid mists and inert particulate material. Utilizing beds of wetted fibers they are finding wide use in treating effluents from such difficult applications as laboratory hoods and open surface tank operations.

Construction of the unit makes it suitable for a wide range of applications. Specific characteristics of the process gas to be treated and the degree of cleaning required will determine the type and number of cleaning stages in the "Buffalo" Gas Absorber. Three distinct gas cleaning components which may be found are: 1. wetted impingement-type cells for removal of particulate materials which would plug fibers if permitted to pass. 2. wetted fiber cells for absorption of gases. 3. dry fiber cells for elimination of fine droplet carry-over from the unit.

The many features of cost, effectiveness and versatility of the "Buffalo" Gas Absorber make it a wise choice for your air pollution control problem.

Investigate the many advantages of "Buffalo" Scrubber Washers *today!* Write for Bulletin AP-125.

'Buffalo' Can Solve YOUR Air Cleaning Problems!

We manufacture a wide line of air cleaning equipment to control many types of air pollution. Your nearby "Buffalo" engineering representative will be glad to analyze your problems and make recommendations. Call him now, or write us for full information.

BUFFALO FORGE COMPANY

Buffalo, New York

Canadian Blower & Forge Co., Ltd., Kitchener, Ont.

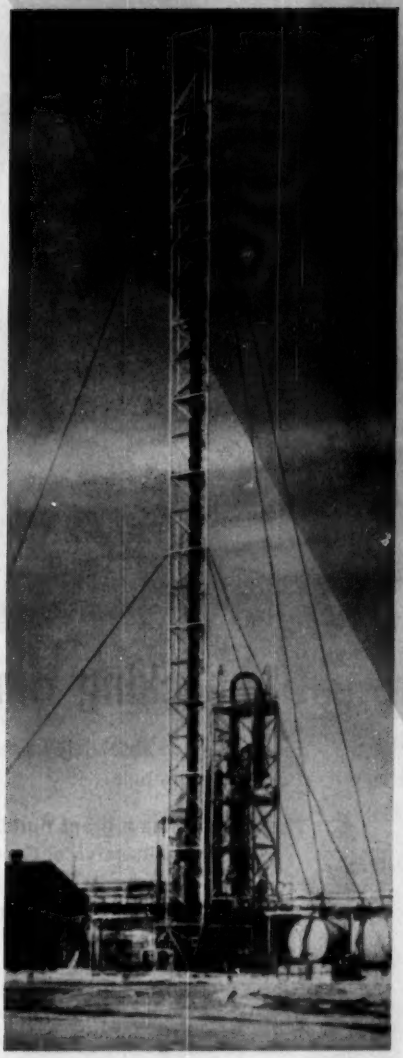
'Buffalo' Air Handling Equipment to move, heat, cool, dehumidify and clean air and other gases.

'Buffalo' Machine Tools to drill, punch, shear, bend, slit, notch and cope for production or plant maintenance.

'Buffalo' Centrifugal Pumps to handle most liquids and slurries under a variety of conditions.

Squier Machinery to process sugar cane, coffee and rice. Special processing machinery for chemicals.

KEEP AHEAD WITH HAVEG



CORROSION CONTROL SPECIALISTS . . .

only HAVEG OFFERS Complete

1. **Equipment Line**
   - pipe & fittings
   - tanks
   - duct
   - towers
   - accessories
2. **Corrosion Resistance**
   - to acids
   - to alkalies
   - to organics
   - to solvents
3. **Selection of materials**
   - phenolics
   - furanes
   - polyesters
   - epoxies
4. **Technical engineering assistance**
   - in process design
   - in material selection
   - in installation recommendation

Keep Ahead with **HAVEG®**

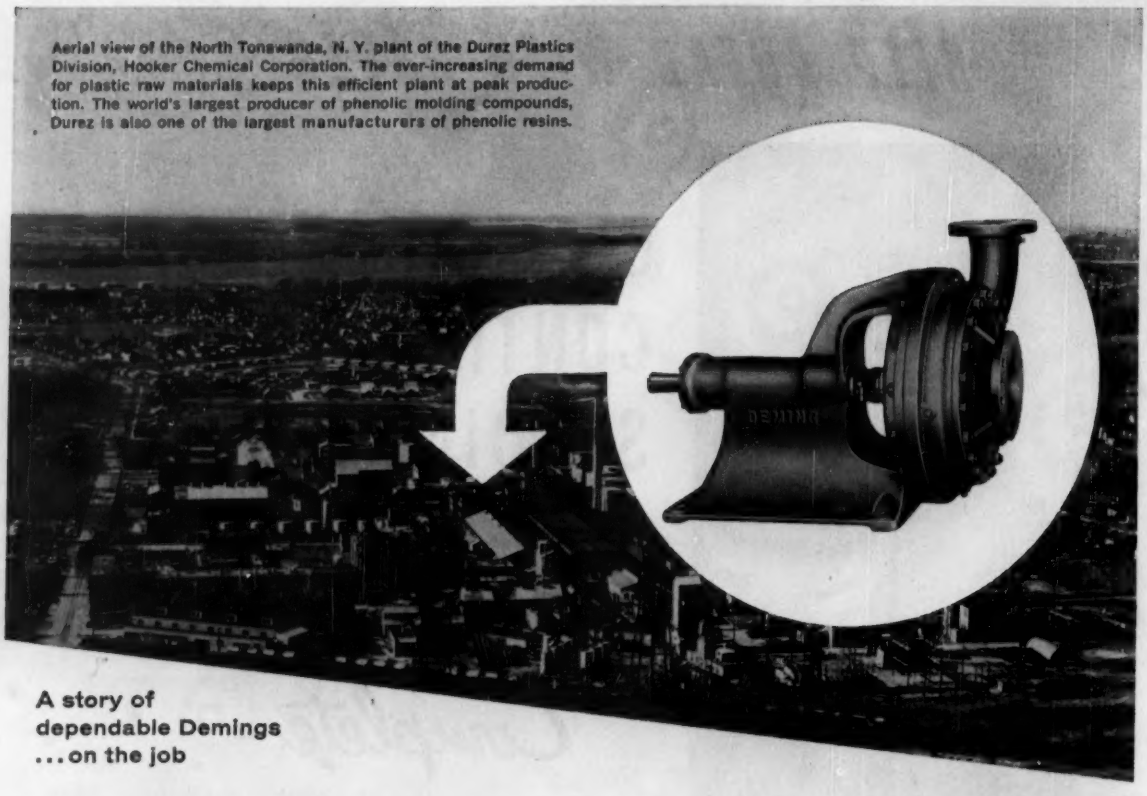
FIRST IN *Engineered* PLASTICS

HAVEG CORPORATION
DIVISION OF
HAVEG INDUSTRIES, INC.
Plastics Park • Wilmington 8, Delaware

For thirty years Haveg has been solving corrosion problems of all types. Today Haveg is *the standard* of the corrosion industry. Haveg Engineers are trained by field experience to evaluate your problem and supply you with that plastic whose service characteristics will resist the chemical attack of your specific corrosive material.

Remember . . . with any corrosion problem . . . it's best to "Keep Ahead with Haveg."

Other Operating Divisions: American Super-Temperature Wires, Inc. – Burlington, Vermont • Blow Molding Division – Bridgeport, Connecticut • Chemical Materials Division – Wilmington, Delaware
Haveg Corporation – Wilmington, Delaware • Hemisphere Products Corporation – Rio Piedras, Puerto Rico • Reinhold Engineering & Plastics Co., Inc. – Norfolk, California



Aerial view of the North Tonawanda, N. Y. plant of the Durez Plastics Division, Hooker Chemical Corporation. The ever-increasing demand for plastic raw materials keeps this efficient plant at peak production. The world's largest producer of phenolic molding compounds, Durez is also one of the largest manufacturers of phenolic resins.

A story of dependable Demings ...on the job

"We forget the pumps are in there until checking time"

MAINTENANCE RECORD	
YEAR	SERVICE
1940	none
1941	none
1942	none
1943	none
1944	none
1945	none
1946	none
1947	none
1948	none
1949	none
1950	none
1951	none
1952	none
1953	none
1954	none
1955	repacked glands
1956	none
1957	none
1958	none
1959	none
1960	none

That's what plant engineers at the Durez Plastics Division, Hooker Chemical Corporation, cheerfully remarked when asked about the service given them by Deming pumps. Here is an example from their maintenance files.

Case History:

A Deming 2½" centrifugal pump was installed at Durez in 1940. This dependable pump performs daily, moving styrene from tank cars. As shown in the record at left, this pump received no maintenance other than repacking of the glands in 1955.

Another dependable Deming centrifugal, bought and installed in 1944, pumps phenol – the basic material of this major plastic manufacturer. Other than being checked and cleaned at regular intervals, this pump has had absolutely no maintenance or downtime!

Durez also has a great number of sump pumps in service. George E. Patterson, Engineering Manager, reports, "Deming sump pumps are not touched, year in – year out."

Jerry Linneman, Durez Maintenance Engineer, states, "Here at Durez we like Deming pumps because of their design, price, and because our efficient operation demands dependable pump performance."

This type of low maintenance and superior service can be yours by simply specifying Deming on your next pump order.

Send today for Catalog E, it will give you complete information on Deming's extensive line of industrial pumps.

The DEMING Company

987 BROADWAY • SALEM, OHIO

increased production up to 4 times—time saving, 30% to 80%

Struthers Wells "Multi-action" Mixer...

for today's heavy duty requirements

In full scale production since 1957, this "Multi-action" Mixer has accelerated production and improved heat transfer. It does the work of 4 "old type" machines—provides rapid heat exchange, excellent mixing and dehydration. Results: sensational savings in time and money.

Struthers Wells

STRUTHERS WELLS CORPORATION

WARREN, PENNSYLVANIA

Plants at Warren and Titusville, Pa.

PROCESSING EQUIPMENT DIVISION

Crystallizers . . . Direct Fired Heaters . . . Evaporators . . . Heat Exchangers . . . Mixing and Blending Units . . . Quick Opening Doors . . Special Carbon and Alloy Processing Vessels

BOILER DIVISION

BOILERS for Power and Heat . . . High and Low Pressure . . . Water Tube . . . Fire Tube . . . Package Units

FORGE DIVISION

Crankshafts . . . Pressure Vessels . . . Hydraulic Cylinders . . . Shafting . . . Straightening and Back-up Rolls

Get the complete story

Send coupon TODAY for your copies

STRUTHERS WELLS CORPORATION
WARREN, PENNSYLVANIA

Please send
Bulletin 581—THE MULTI-ACTION MIXER ☐
Technical Paper #60—GREASE MIXER DESIGN ☐

Name_____

Title_____

Company_____

Address_____

Cost-cutting step taken 26 years ago still paying off at Hamm Brewery —they chose NONPAREIL Turbine Oil

Situation: In 1934 the Theo. Hamm Brewing Company installed two 1,000 kw. turbines. The brewing firm wanted to be sure there would be no downtime due to failure of the lubricant. Neither did the company want to spend time checking the oil's performance or adding new oil to sweeten the old.

What was done: Brewery management followed the advice of the Standard Oil lubrication specialist. They installed NONPAREIL Turbine Oil, the only oil, then as now, that carries with each fill a life-of-turbine guarantee.

What has happened: In 26 years since the turbines were put in service there has never been any downtime due to lubrication problems. In 1947 a 2500 kw. turbine was added to the system and another 3000 kw. unit was put in service in 1953. These, too, have used NONPAREIL Turbine Oil with the same results.

What you can do: Get the full story on NONPAREIL Turbine Oil from the Standard Oil office near you in any of the 15 Midwest and Rocky Mountain states. Or write **Standard Oil Company (Indiana), 910 South Michigan Avenue, Chicago 80, Illinois.**

Quick facts about **NONPAREIL Turbine Oil**

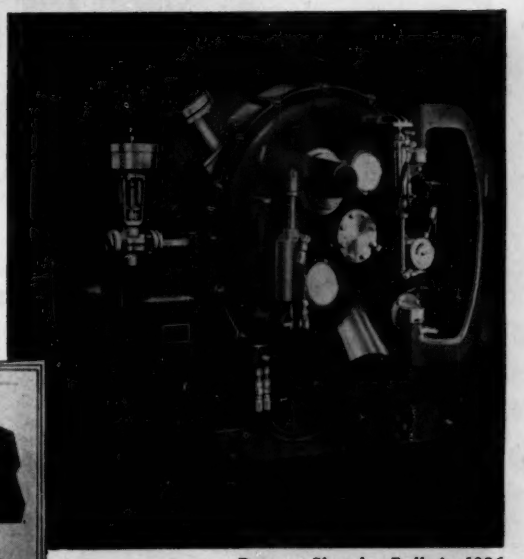
- Will not permit formation of harmful acids
- Will not permit formation of sludge or oil varnish
- Will maintain good demulsibility or water separating characteristics
- Has high resistance to foaming
- Contains adequate rust inhibitor

You expect more from **STANDARD** *and you get it!*

Hamm Brewing Co. assistant chief engineer Steve Wappel and Standard's Dick Anderson discuss recent oil analysis. Dick Anderson knows his way about an industrial power plant. He's been providing customers with technical service on lubrication for five years. Dick has an engineering degree from the University of Minnesota and has completed the Standard Oil Sales Engineering School.

the unbeatable combination—

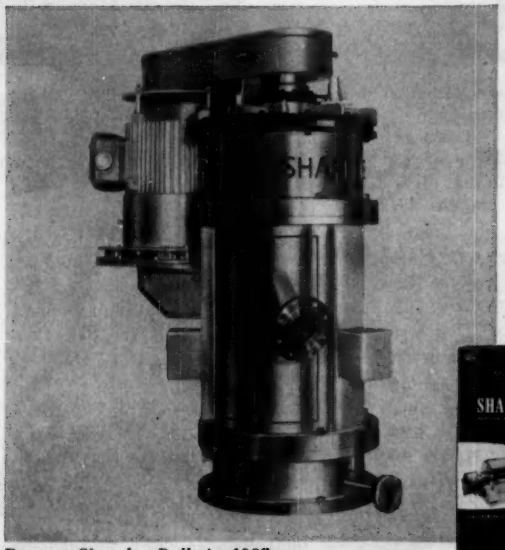
FOR PRESSURE OPERATION . . .

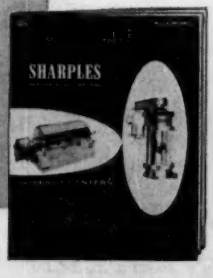


Request Sharples Bulletin 1286

SUCCESS STORY:
The Super-D-Hydrator and deliquefication of the Polyolefins

Over the past year, more than a dozen Sharples C-41 and C-27 Super-D-Hydrators have been operating day in and day out on production lines where extreme high purity, dryness of solids, and high capacity are essential . . . where crystals and fine compressible solids such as the polyolefins are deliquefied, multiple-washed, and dried in pressurized systems. This outstanding record speaks for itself as orders come in for additional machines, and new programs specify "Super-D-Hydrators" down the line.





Request Sharples Bulletin 1287

ADVANCE PERFORMANCE:
The P-4000 Super-D-Canter Leads New Process Development.

For sealed operation at up to 150 psig pressure, or under vacuum, the Sharples exclusive vertical Super-D-Canter will continuously handle a wide range of particle sizes in slurries with solids concentration of from ½ to 50%. This truly pressurized centrifuge fills a need which already is being reflected in the new more profitable processes which are supplanting many more conventional approaches. It will pay you to know the facts of the P-4000 Super-D-Canter.

The Super-D-Hydrator and P-4000 Super-D-Canter . . . Sharples Exclusives.

THE SHARPLES CORPORATION

Centrifugal and Process Engineers

2300 WESTMORELAND STREET / PHILADELPHIA 40, PENNSYLVANIA

NEW YORK • PITTSBURGH • CLEVELAND • DETROIT • CHICAGO • HOUSTON • SAN FRANCISCO • LOS ANGELES • ST. LOUIS • ATLANTA

Associated Companies and Representatives throughout the World

HIGHER Thermal Efficiencies . . . . . GREATER Savings In Industrial Process Heating!

THE HI-TURBIANT HEATER

If you have any process operations — large or small — where process fluids are heated, directly or indirectly, investigate now the substantially greater thermal efficiencies and lower operating costs the Hi-Turbiant Heater is bringing to other processing applications similar to yours.

▶ As shown in the cutaway view, the Hi-Turbiant has both radiant and re-radiant heating zones — a unique advancement that insures more uniform heat absorption throughout the entire tubular network!

▶ High fluid turbulence, maintained by high-temperature pumps, reduces boundary-layer vaporization and assures substantially greater heat efficiencies without vaporization problems!

▶ More uniform heating permits greater height-to-diameter ratio — therefore fewer "hairpins" in the tube system for more efficient fluid flow, lower pumping costs, greater operating economies!

Because of these and other unique Hi-Turbiant advancements, you make multiple savings in process heating applications — savings in size of unit required, savings in fuel costs, savings in pumping costs, savings in plant space. Send for illustrated bulletin that gives detailed data and shows typical systems. *Ask for Bulletin # HT-100!*

TWO BROAD FIELDS OF APPLICATION!

1. Heating Transfer Fluids (Dowtherm, Aroclor, Hydrocarbon oils, etc.) used in heat processing.
2. Direct Firing of process streams (Rich-Oil denuding, asphalt heating, etc.) where fluids must be heated under close thermal control.

In both types of application, the Hi-Turbiant Heater brings new standards of efficiency, new savings in processing costs!

COMPLETE RANGE OF SIZES — ½ TO 40 MILLION BTU/Hr.

Also, single user "package" units 200,000 to 1,500,000 BTU/Hr.

There's a Hi-Turbiant Heater to fit your requirements!

WESTERN
PRECIPITATION
DIVISION OF JOY MANUFACTURING COMPANY

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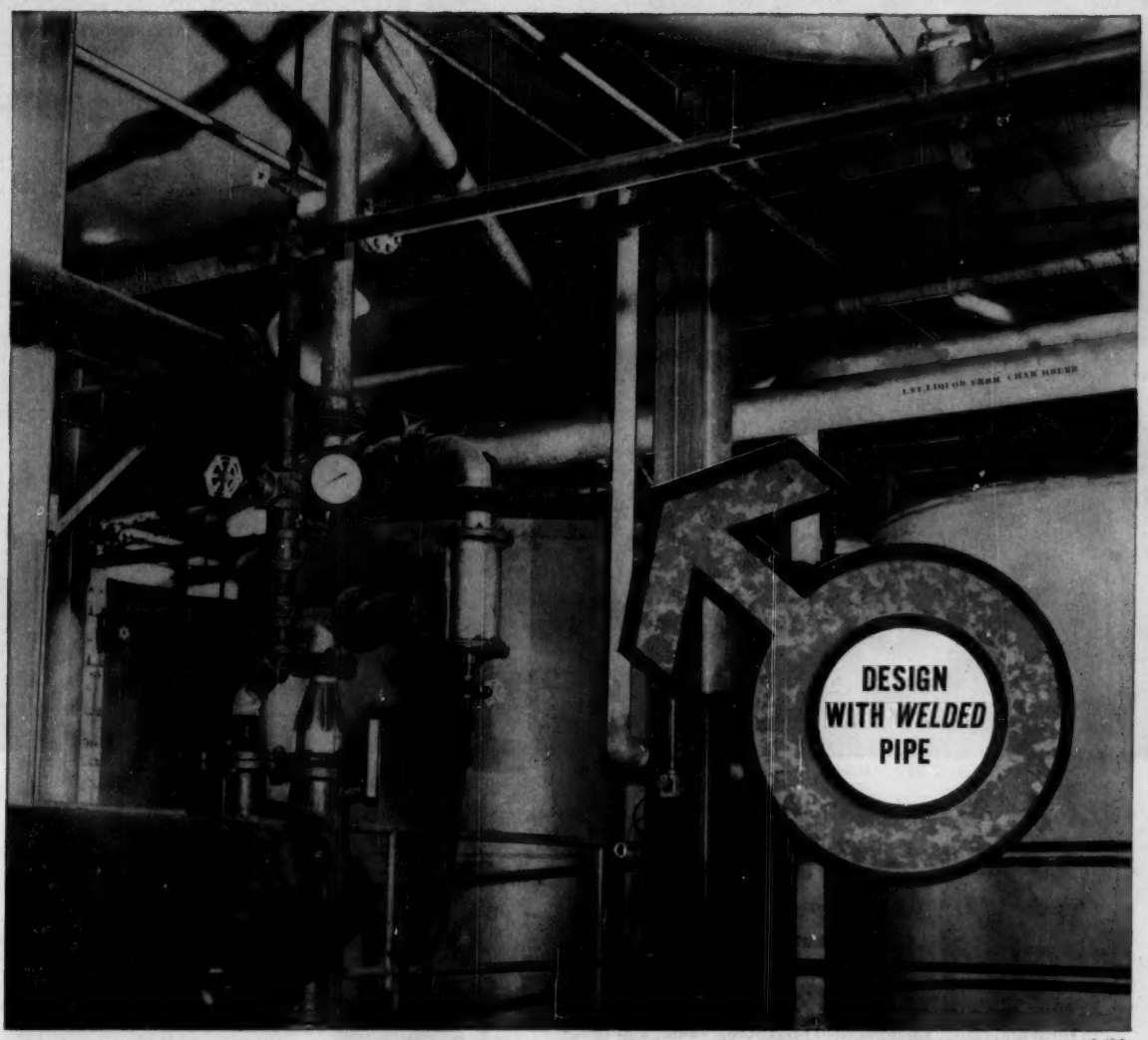
IN CANADA: 8582 MOUNTAIN SIGHTS AVENUE, MONTREAL, P. Q.



LC-606

WELDED STAINLESS PIPING WINS

on "killer" duty in Southern Sugar Refinery

Corrosive liquors piped over long distances in this sugar refinery service—often at temperatures of from 180°F to 220°F—played havoc with non-ferrous metal piping. Down times occurred two or three times a year for pipe replacement and costs climbed accordingly . . . until welded stainless pipe entered the picture. Now, with Type 347 stainless on the job the problem is solved. Frequent down times are eliminated, thanks to the alloy's superior corrosion resistance, and as an important bonus, freedom from product contamination is achieved. • Why not check into the profit possibilities of modern welded steel piping in your own operation? Ask for helpful Bulletin 8591—and consult a quality welded steel pipe producer in your district.

Welded Steel Tube Institute, Inc.

1604-J Hanna Building, Cleveland 15, Ohio

• Armco Steel Corp. • The Babcock & Wilcox Co., Tubular Products Div. • The Carpenter Steel Co., Alloy Tube Div. • Clayton Mark & Co. • Damascus Tube Co. • Jones & Laughlin Steel Corp., Electricweld Tube Div. • National Tube Div., United States Steel Corp. • Ohio Seamless Tube Div. of Copperweld Steel Co. • Republic Steel Corp., Steel and Tubes Div. • Revere Copper and Brass Inc., Rome Manufacturing Company Div. • Sawhill Tubular Products, Inc. • Southeastern Metals Co. • The Standard Tube Co. • Superior Tube Co. • Trent Tube Co., Subs. Crucible Steel Co. of America • Union Steel Corp. • Van Huffel Tube Corp. • Wall Tube & Metal Products Co.

Low cost, excellent resistance to corrosion:

FEDERATED CHEMICAL LEAD sheet, pipe, fittings, linings

Federated lead products are self-healing; malleable, easy to form and bend; salvable with high scrap value; and probably the most efficient protection you can find for many corrosive chemical conditions. These products include chemical lead sheets to your requirements; pipe, bends, traps and standard fittings available from stock; special forms fabricated to order. Write for Bulletin No. 162, the Lead Handbook for the Chemical Process Industries, to Federated Metals Division, American Smelting and Refining Company, 120 Broadway, New York 5, RE 2-9500; or call your nearest Federated sales office.

ASARCO

AMERICAN SMELTING AND REFINING COMPANY

FEDERATED METALS DIVISION

Where to call for information:

ALTON, ILLINOIS
Alton: Howard 5-2511
St. Louis: Jackson 4-4040

BALTIMORE, MARYLAND
Orleans 5-2400

BIRMINGHAM, ALA.
Fairfax 2-1802

BOSTON 16, MASS.
Liberty 2-0797

CHICAGO, ILL. (WHITING)
Chicago: Essex 5-5000
Whiting: Whiting 826

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Cherry 1-1678

CLEVELAND, OHIO
Prospect 1-2175

DALLAS, TEXAS
Adams 5-5034

DETROIT 2, MICHIGAN
Trinity 1-5040

EL PASO, TEXAS
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ROCHESTER 4, NEW YORK
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Whiting: Whiting 826
Chicago: Essex 5-5000

IN CANADA: Federated Metals Canada, Ltd.
Toronto, Ont., 1110 Birchmount Rd., Scarborough, Phone: Plymouth 73246
Montreal, P.Q., 1400 Norman St., Lachine, Phone: Melrose 7-3591

MATERIAL CHARACTERISTICS	HARD TO VERY HARD	BRITTLE FRIABLE	SOFT	WET STICKY	FIBROUS
TYPE OF CRUSHER	Gyratory Hammermill One-way Reversible Impactor Jaw Single Roll	Bradmill Gyratory Hammermill One-way Reversible Impactor Jaw Single Roll	Bradmill Gyratory Hammermill One-way Reversible Impactor Jaw Single Roll	Hammermill Non-clog Single Roll Non-clog	Hammermill One-way Reversible Single Roll

HOW TO SELECT THE RIGHT CRUSHER FOR YOUR MATERIAL

Crushing machines usually represent fair size investments. Also the cost of operation, and the quality and uniformity of the product, are two important factors in *your* product and profit picture.

So you want to be *sure* to select the right crushers.

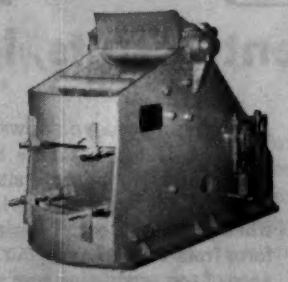
The chart above will give you a clue. The types of Pennsylvania crushers mentioned can be considered for specific applications. But materials vary considerably in physical and chemical characteristics; and type of product desired and rate of production are equally important. So more help is usually needed.

EXPERIENCED ASSISTANCE

That's where Pennsylvania engineers and Pennsylvania laboratory facilities move in to help you. The engineers have a wealth of know-how. The laboratories offer unexcelled facilities for product analysis and test runs of your material. Together they will determine beyond any doubt the *right* crusher for *your* problem. This help is at your disposal freely and without obligation. See Pennsylvania first.

FREE BULLETINS

Just to increase your store of knowledge on crushing procedures, why not send for our bulletin on "How To Select a Crusher." It describes the various kinds of mechanical reduction, and the types of Pennsylvania crushers that supply each one.



● Pennsylvania KUE-KEN Jaw Crusher —the crusher that employs the "crushing without rubbing" principle. Widely used for crushing a variety of materials in the chemical industries. Described in Bulletin 5012.

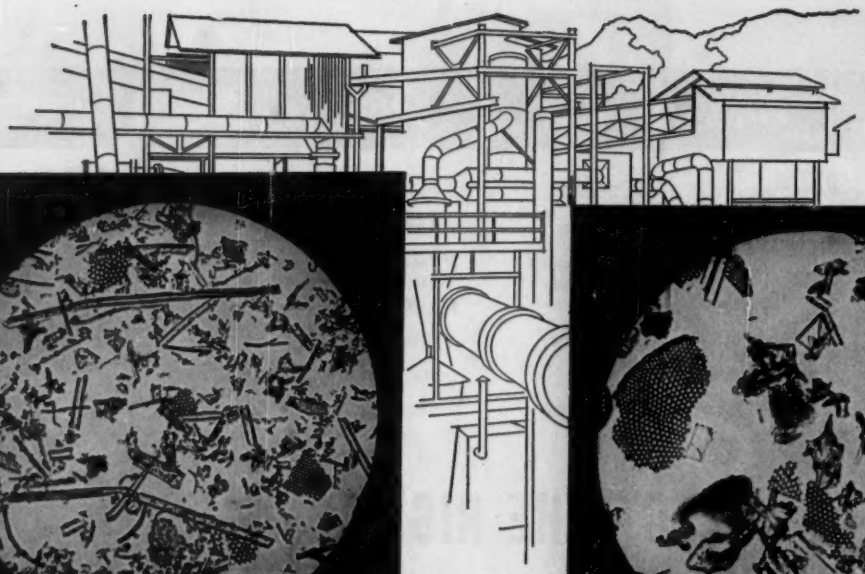
PENNSYLVANIA CRUSHER DIVISION
BATH IRON WORKS CORPORATION
WEST CHESTER, PENNA.

* * *

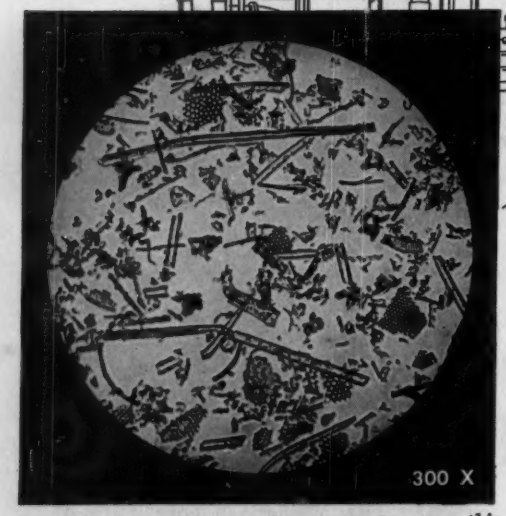
Over 50 years concentrated experience in all types of material reduction makes Pennsylvania your best source of crushers and engineering advice and service. Call on Pennsylvania with your next crushing problem. Representatives from coast-to-coast.

PENNSYLVANIA CRUSHERS

BATH-BUILT



Milling and calcining equipment used for all Celite grades.

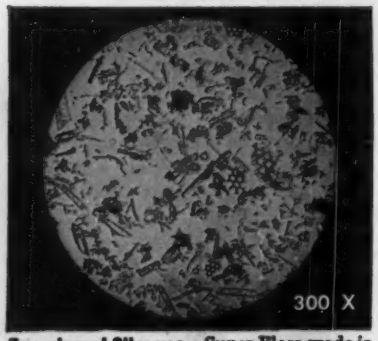


For high-clarity filtration of most liquids—use this specially milled diatomite, Hyflo Super Cel.

For filtration of larger suspended particles—Celite 545 combines maximum clarity plus faster flow rates.

In diatomites, Johns-Manville precision processing works for you

Constant uniformity in every grade of Celite assures consistent results, less down-time



For mineral filler use—Super Floss grade is made up of carefully sized fines air-floated off in the bag house.

Typical J-M bag house equipment.

As the microscope shows, each grade of Celite* diatomite has its own distinctive particle size distribution. Yet no matter where or when purchased, each remains uniform from bag to bag—your assurance of top production results with minimum down-time.

Three examples of flux-calcined Celites are shown here. Hyflo® Super Cel is widely used for filtration in many industries. It has just the right combination of coarse and fine particles to assure optimum clarity and flow rates. Celite 545, with a higher percentage of coarse particles, is used to achieve maximum clarity and faster flow rates with liquids that have larger suspended particles.

Super Floss, one of several bag house grades, has fine particle size distribution. A white powder, it is processed within very narrow tolerances (less than 1% retained on 325 mesh). It is a popular filler in fine products such as silver polishes.

Johns-Manville can precision-produce so many different grades of Celite because it mines the material from the world's largest and purest commercially available deposit. For assistance with specific filtration or mineral filler problems, talk to a nearby Celite engineer. Or write direct to Johns-Manville, Box 14, New York 16, N. Y. In Canada, Port Credit, Ontario.

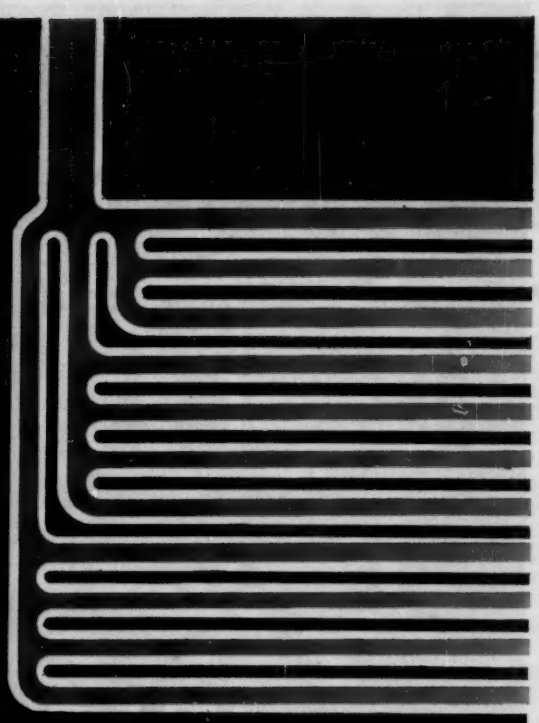
*Celite is Johns-Manville's registered trade mark for its diatomaceous silica products.

JOHNS-MANVILLE

MULTI-ZONE

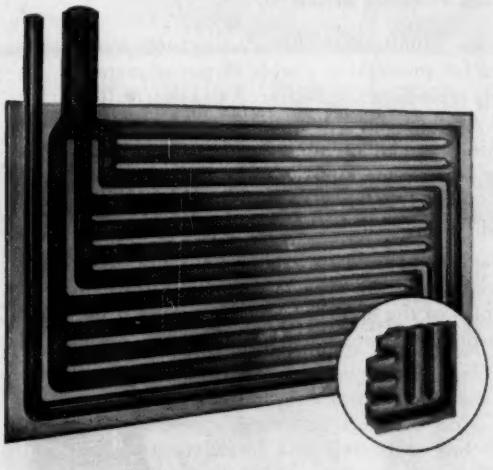
PLATECOIL®

IS AN EXCLUSIVE TRANTER ADVANCEMENT IN HEAT TRANSFER TECHNOLOGY



The new MULTI-ZONE PLATECOIL introduces a new principle of coil design. The multiple header, multiple return pass arrangement produces FREE-FLO action. Steam is distributed to all levels of the coil almost instantaneously. This new design overcomes the problem of condensate "trapping" — a disadvantage of common pipe coils and single-headered units—that robs effective heat transfer area. Only TRANTER PLATECOIL offers the extra capacity of MULTI-ZONE heat distribution.

MULTI-ZONE PERFORMANCE SOLVES TOUGH TANK AND PROCESS HEATING PROBLEMS



Better steam distribution provides a reserve capacity for heat transfer to overcome overload conditions which drop tank and process vessel temperatures. Heat-up time after tank or processing equipment shut-down is cut to a minimum. Tank temperatures are maintained within closer limits and production is improved.

More effective heat transfer area and more heat transfer per square foot of area makes it possible to use fewer and more compact PLATECOIL units than is possible with other types of equipment. Valuable tank space is saved and the need for addition of new tanks to get higher production is often eliminated.

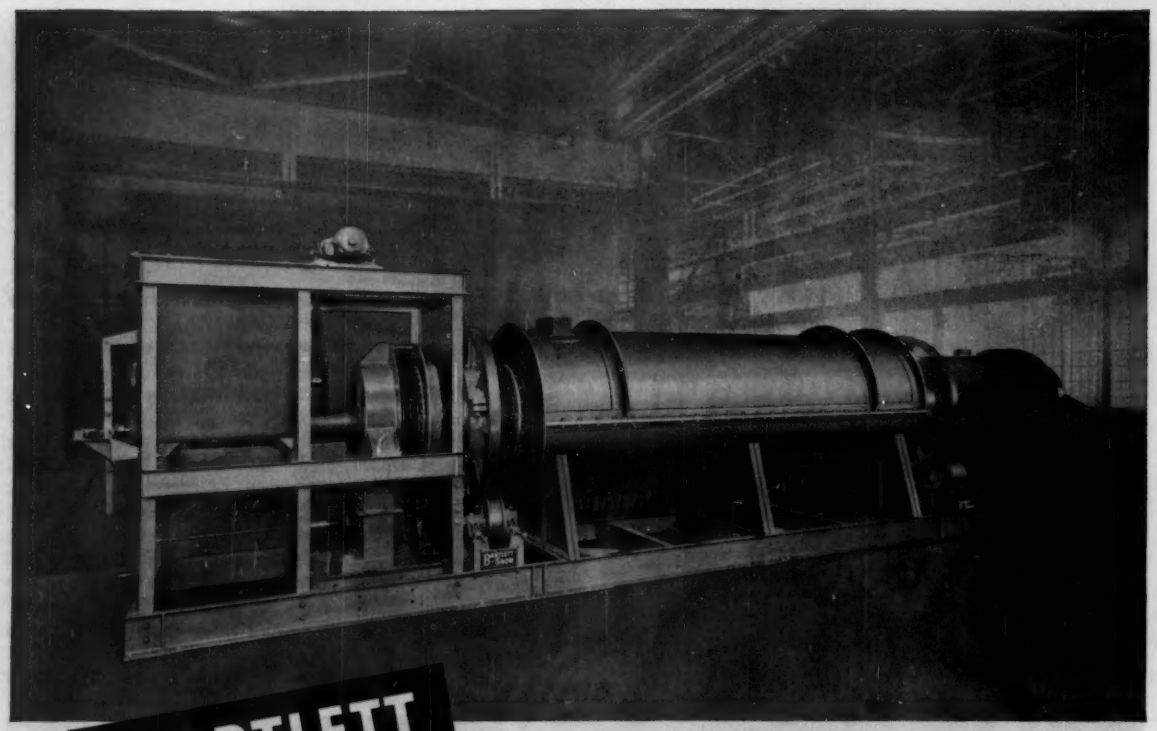
Add to these performance advantages, low cost of installation and operation, economical maintenance and scientific engineering for the best answer to your heat transfer problems.

Write for NEW Bulletin P61 for complete data.

Tranter Manufacturing, Inc.

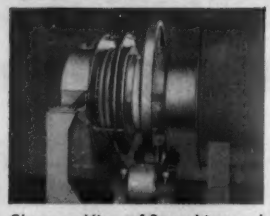
LANSING 9, MICHIGAN

PLATECOIL® DIVISION



BARTLETT-SNOW ROTARY CALCINERS

CLEVELAND 5, OHIO



Close-up View of Breeching and Bellows Type Seal to Maintain Special Atmosphere.

High Temperature Rotary Calciner Showing Electrically Heated Furnace and Integral Cooler.

...permit materials to be processed continuously at temperatures to 2100°F. in a reducing, oxidizing or neutral atmosphere, and cooled to approximately 200°F. before discharge.

Bartlett-Snow Continuous Combination Rotary Calciners and Coolers are ideally suited for processing a wide variety of materials. The entire assembly including the fuel fired or electrically heated refractory lined furnace, feed hopper, variable speed feeder, seals, and breechings are all supported on a single rigid frame to assure proper alignment and efficient, trouble-free operation. Tubes are made of special alloys as dictated by the material being processed.

Complete laboratory facilities enable us to determine the time cycle, temperature, special atmosphere and other conditions—and produce actual samples of the final product before the production unit is designed or built. Let us work with *you* on *your* next job!

DESIGNERS
ENGINEERS
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THE C. O. BARTLETT & SNOW CO.

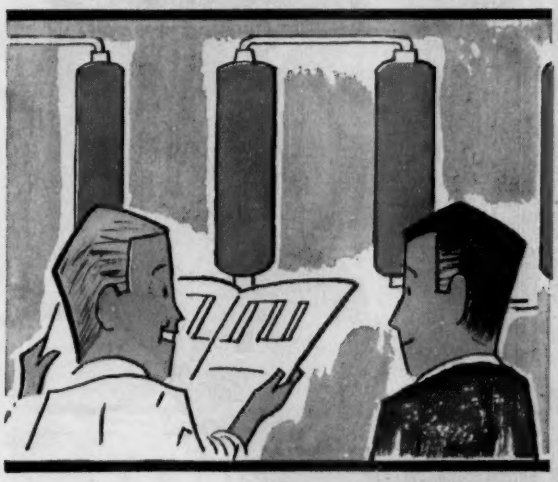
6215 Harvard Ave., Cleveland 5, Ohio

DRYERS • COOLERS • CALCINERS • KILNS

Bulletin No. 118 gives full details. Send for a copy Today.

PITTSBURGH ACTIVATED CARBON Service in Action–

From initial discussion ..... through pilot testing .....



with "in-plant" technical service ..... based on practical adsorption "know-how"

Complete Service from Pittsburgh Chemical Co.

Whether you're considering a new adsorption system . . . trying to obtain maximum efficiency from your present system . . . or concerned with general adsorption problems, Pittsburgh stands ready to assist you in all phases of adsorption engineering.

Pittsburgh technical representatives, who sell and service Pittsburgh Activated Carbons only, are thoroughly experienced and trained to put their adsorption "know-how" to work for you. A Pittsburgh evaluation of your present system, for example, may enable you to significantly reduce processing costs, increase efficiency and improve end product quality. If you are planning a new plant, a technical representative will work right along with your engineers, if desired, from laboratory scale to "on stream" operation.

Investigate the proven advantages of Pittsburgh Granular Carbon. Write or call for the services of a Pittsburgh Technical Representative. He'll be pleased to discuss adsorption with you from a practical standpoint . . . *without any obligation.*

2365

ACTIVATED CARBON DIVISION

PITTSBURGH CHEMICAL CO.

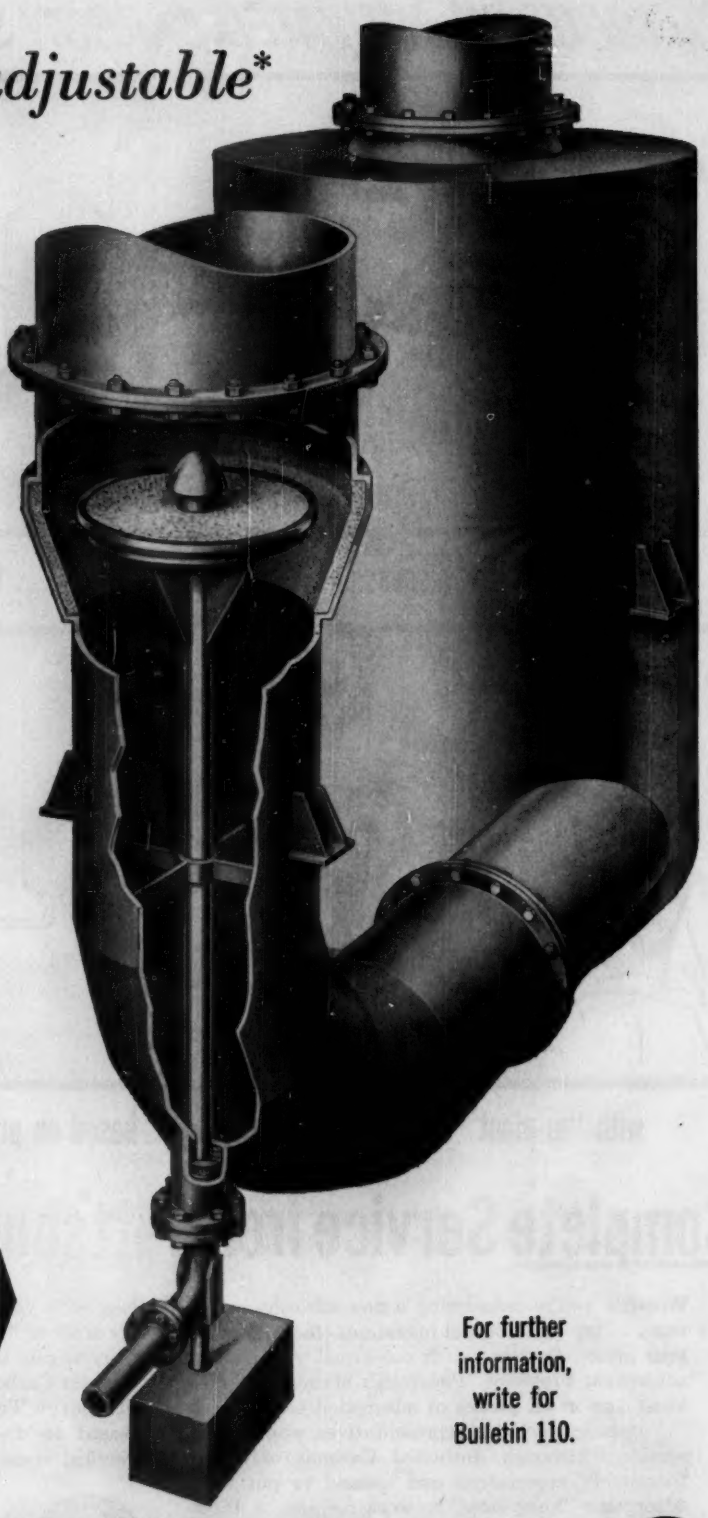
GRANT BUILDING PITTSBURGH 19, PA.

A Subsidiary of PITTSBURGH COKE & CHEMICAL CO.

*Completely adjustable**

Flooded Disc Scrubber

Removes Sub-Micron Fumes



The Research-Cottrell high efficiency scrubber uses the unique flooded disc principle for removing sub-micron fumes in steel-making furnaces and chemical processing.

As shown in the illustration, the outstanding feature of this scrubber is the simple, adjustable "flooded disc." The flooded disc adjusts for maximum cleaning efficiency over a wide range of operating conditions.

* *Automatic positioner immediately adjusts the disc to meet your varying gas and dust control problems.*

Research-Cottrell, with over 48 years of industrial gas cleaning experience, will be glad to consult with you on any specific problem.

For further information, write for Bulletin 110.

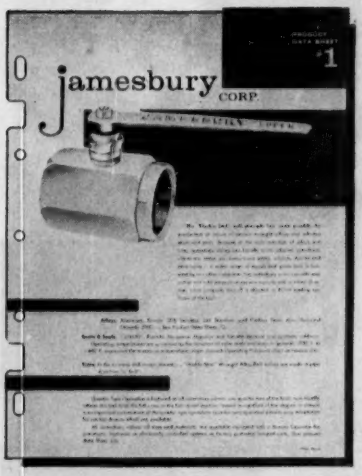
Research-Cottrell

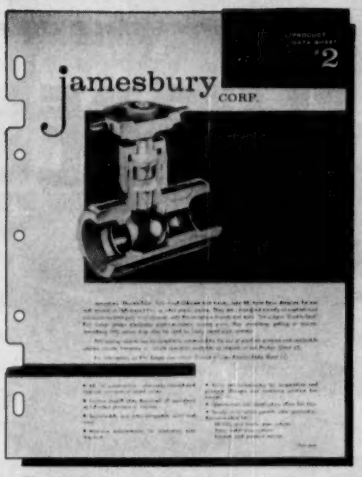
COTTRELL TRADE MARK

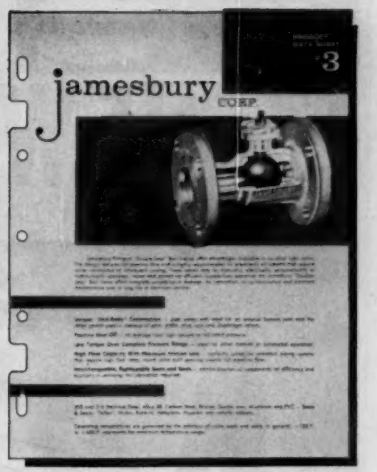
RESEARCH-COTTRELL, INC., Main Office and Plant: Bound Brook, N. J.
Representatives in principal cities of U.S. and Canada

RC107

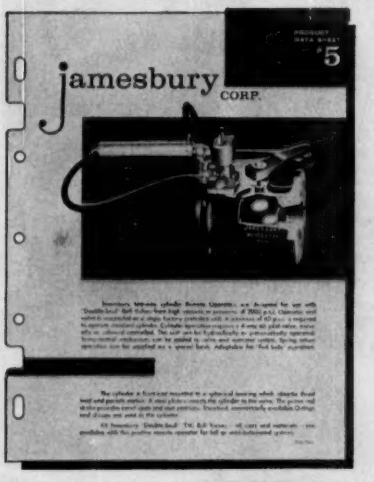
Yours For The Asking!

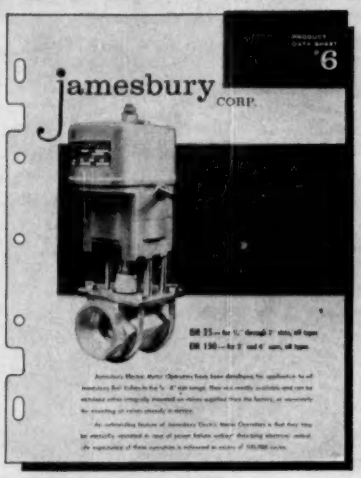


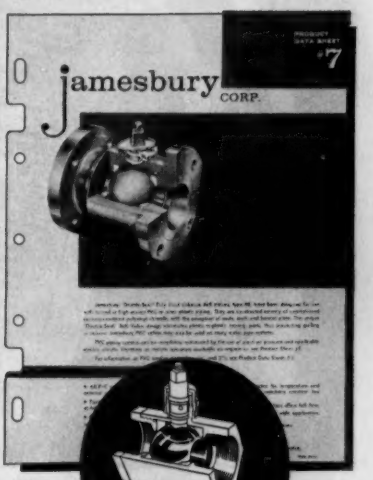


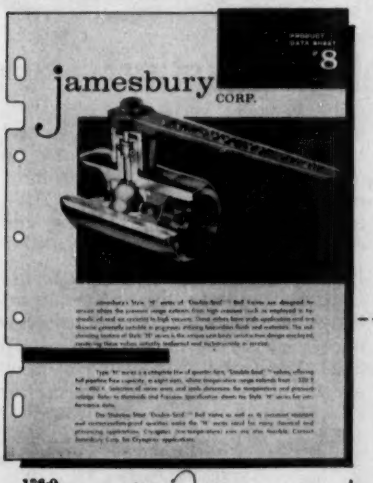


FACTUAL DATA









on Jamesbury BALL VALVES

AS VERSATILE AS INDUSTRY ITSELF

Get the full story on Jamesbury Corp.'s complete line of "Double-Seal" Ball Valves and accessories. Learn why the Jamesbury "Double-Seal" Ball Valve has been labeled "as versatile as industry itself". Get all the facts on materials, sizes, etc. They are yours for the asking: the facts about Jamesbury Corp. – the nation's foremost exclusive manufacturer of Ball Valves.

JAMESBURY CORP.
NEW STREET, DEPT. PDS, WORCESTER, MASS.
Please send me the Data Sheets checked below.

#1 #2 #3 #5 #6 #7 #8

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Company.....

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126-0

JAMESBURY BALL VALVES
HELPING BUILD OUR NUCLEAR NAVY

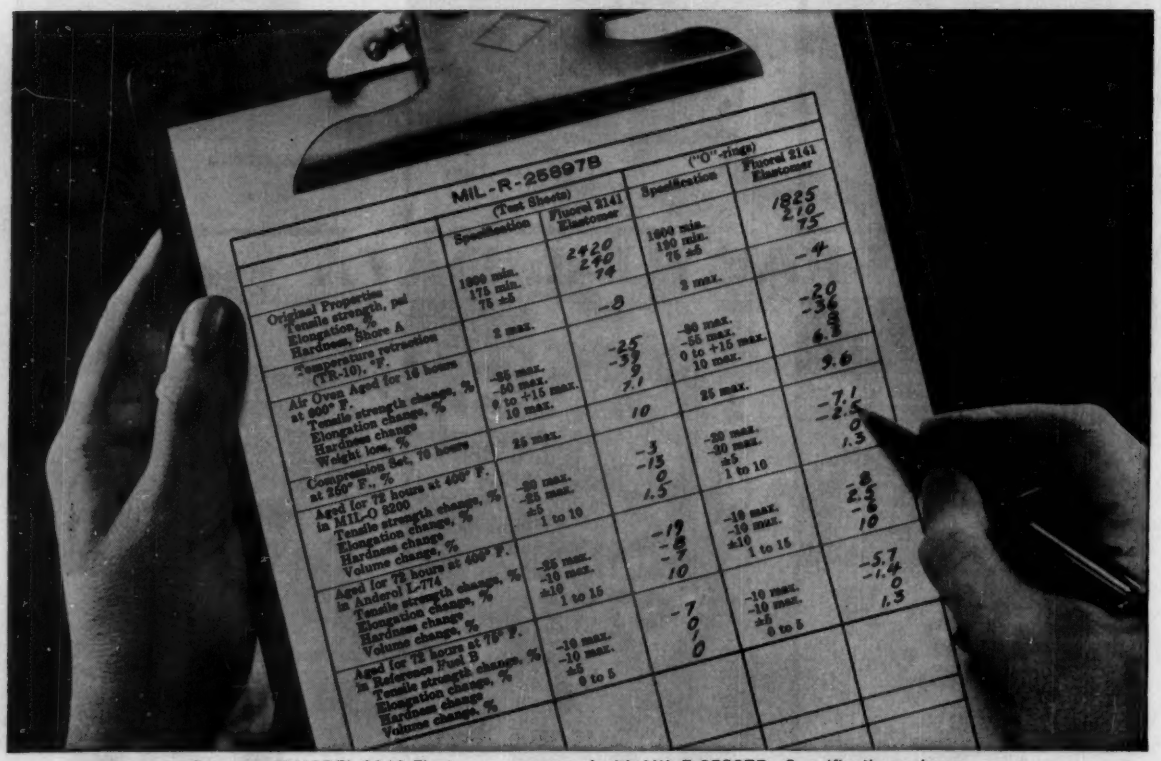
JAMESBURY CORP., 62 NEW STREET, WORCESTER, MASS.
Distributors in Principal Cities

3M COMPANY CHEMICALS

THE RAW MATERIALS OF PROGRESS

NEW FLUOREL® 2141

BRAND ELASTOMER



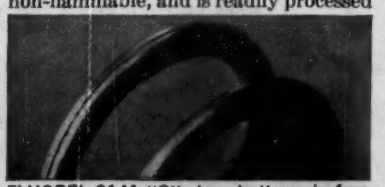
Compare FLUOREL 2141 Elastomer compound with MIL-R-25897B—Specifications above.

MIL-R-25897B quality—now available in quantity

Compounders throughout the U.S. can now supply all your needs for a maximum quality compound according to "MIL-specs" with new FLUOREL 2141 Brand Elastomer.

This new elastomer—because of its outstanding Mooney Scorch Rating, plus other qualities—provides the solution for applications where high temperatures and corrosive media prevail . . . gives you the extra margin of safety available only from a compound that can meet military specifications. Rated for continuous service at 400°F, it can withstand 600°F. temperatures, and higher, for reduced periods of time under certain service conditions.

FLUOREL 2141 Elastomer provides excellent resistance to corrosive chemicals, fuels, solvents and ozone. It is non-flammable, and is readily processed on standard rubber compounding and fabricating equipment. It may be molded, extruded and bonded to most metals . . . is finding broad application in aircraft, missile, automotive and chemical industries.



FLUOREL 2141 "O" ring, bottom, is free from defects of elastomer "O" ring, top.

Examine your present elastomeric and/or rubber products with an eye toward improving their quality and performance through use of new FLUOREL 2141 Elastomer. Specify this new elastomer to your compounder. For complete data, write to: 3M, Chemical Division, Dept. KAL-90, St. Paul 6, Minnesota.

®"FLUOREL" is a reg. T.M. of 3M Co.

CHEMICAL DIVISION

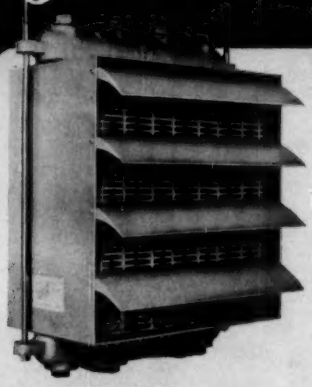
MINNESOTA MINING AND MANUFACTURING COMPANY

. . . WHERE RESEARCH IS THE KEY TO TOMORROW

3M COMPANY

GRID's got to be good!

The best guarantee any product can have is its users.



LOOK at the plants that depend upon

GRID

UNIT HEATERS
BLAST HEATERS
RADIATORS

for a trouble-free, low maintenance cost heating system - One that will serve without service - Installations made in 1929 are still operating without need for repairs. GRID'S design and construction makes the difference!

GRID Cast Iron Construction resists corrosion externally from acid fumes and internally from electrolysis. No leaking from rotted cores.

GRID one-piece cast iron heating sections and headers are leak-proof on steam pressures up to 250 p.s.i. 450° temperature. Smaller steam lines cost less.

GRID heating sections with widely spaced fins cast integral with steam chambers are easy to clean - Will not "mat" on air intake side.

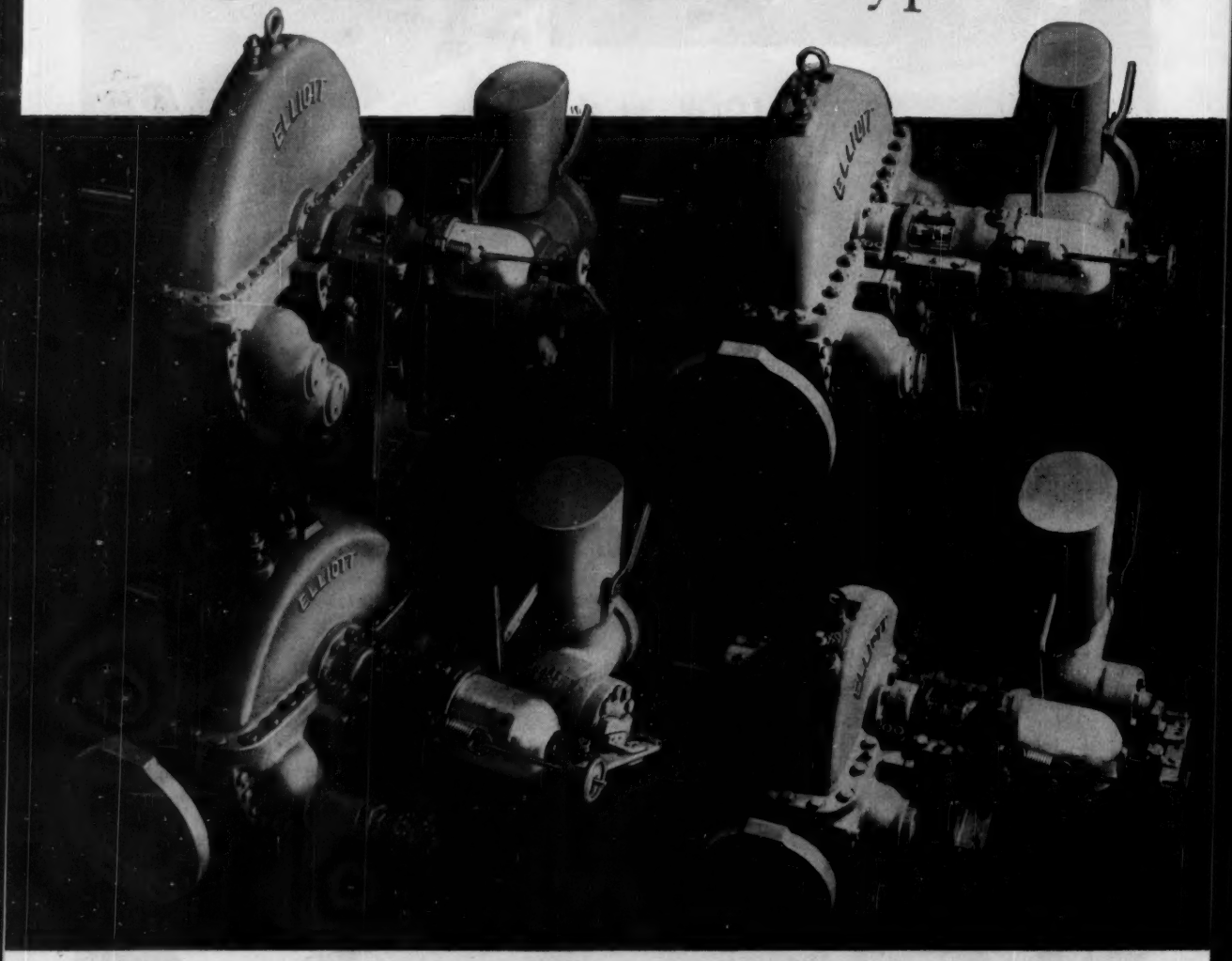
GRID design develops low outlet temperatures and with proper fan volumes, delivers warm, comfortable air to floor - No wasted heat at ceiling.

Get complete information on a GRID System for your plant. Write for catalog #956 GRID CAST IRON STEAM HEAT TRANSFER SURFACE.

Representatives in principal cities

D. J. MURRAY MANUFACTURING CO.
Manufacturers Since 1883

ELLIOTT mechanical drive TURBINES type YR



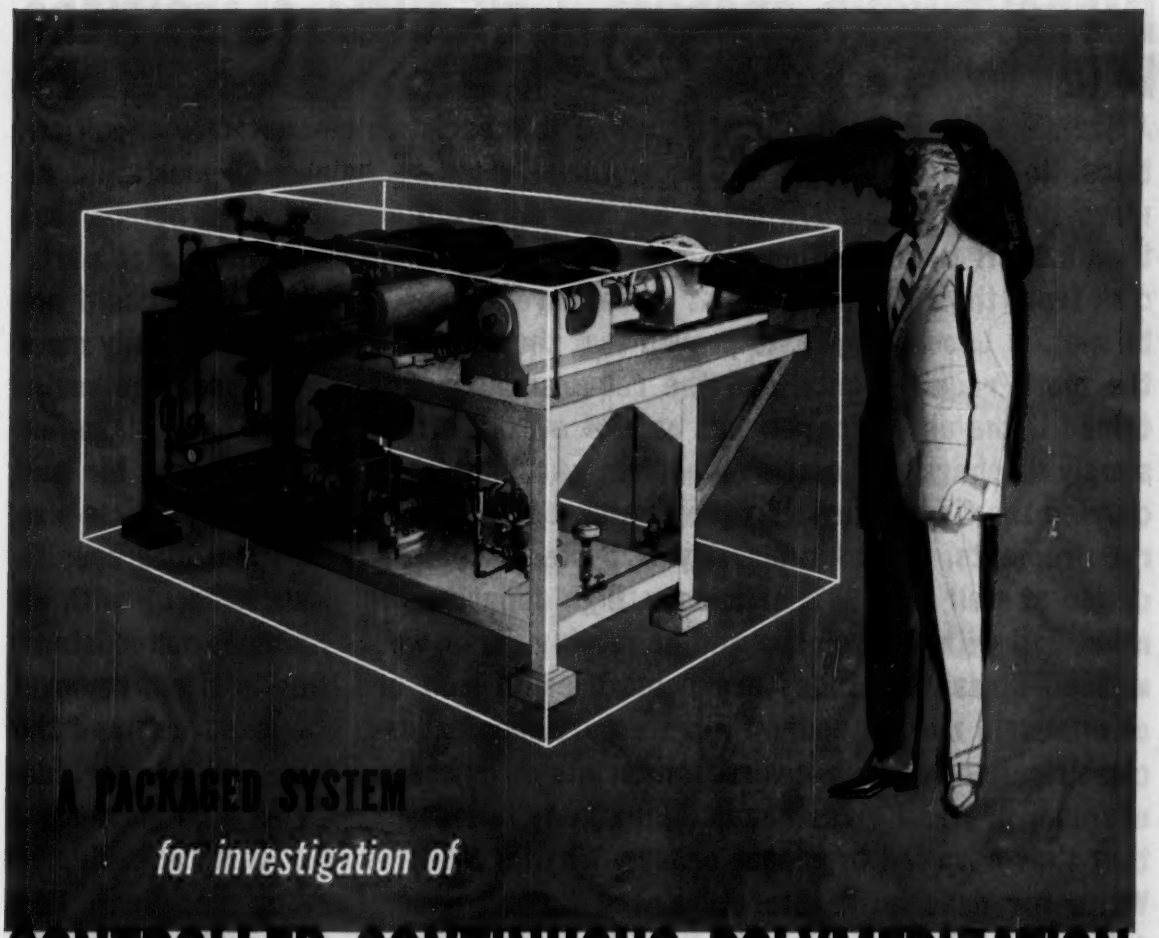
All-weather protection, standard for Elliott type YR turbines, assures dependable operation under all conditions of heat, cold, moisture, dust and contaminated atmosphere.

The direct-acting speed-governing system is simple and positive, available in several modifications to match speed and pressure requirements. The rugged rotor assembly is dynamically balanced. Bearings and shaft seals are readily accessible for maintenance. Hand valve reduces steam consumption at partial loads.

Many other features contribute to the dependable and economical performance of Elliott type YR turbines. Write for complete details to Turbine Division, Elliott Company, Jeannette, Penna.

HO-9

ELLIOTT Company
Jeannette, Pennsylvania



A PACKAGED SYSTEM

for investigation of

CONTROLLED CONTINUOUS POLYMERIZATION

VOTATOR* processing equipment is used for continuous polymerization reactions in numerous installations. It affords fast, efficient, controlled processing not possible in batch reactors.

Girdler's experienced engineers operate extensive pilot facilities to provide exact specifications for scaling up to production equipment. VOTATOR engineered systems are designed to meet your own specific process requirements. These systems provide a high degree of flexibility and versatility. They save materials, use less floor space and assure significant overall operating economy.

Rugged, dependable VOTATOR continuous reactors are fabricated by skilled craftsmen in strict compliance with ASME codes. Materials of construction are carefully selected according to the properties of products processed.

Packaged VOTATOR pilot systems are now available for studies of continuous reaction processes in your plant. For additional information write Girdler Process Equipment Division, P.O. Box 43, Louisville 1, Kentucky.

*VOTATOR—Reg. U. S. Pat. Off.

GIRDLER PROCESS EQUIPMENT DIVISION

CHEMETRON CORPORATION

Louisville 1, Kentucky

CHEMETRON

VOTATOR CONTINUOUS PROCESSING EQUIPMENT FOR CHEMICAL & FOOD INDUSTRIES • VOTATOR PISTON & GRAVITY FILLERS • VOTATOR PLANTS FOR FATTY OILS INDUSTRY • THERMEX DIELECTRIC HEATING EQUIPMENT

IMPROVE YOUR PRODUCT WITH BUELL CLASSIFIERS

A sodium phosphate manufacturer had to meet stricter customer specifications. No more than 15% of the material could be below 100 mesh and no more than 1% below 270 mesh. But the apparent density could not be less than 0.98. If the classifier removed too much of the intermediate size particles from the finished product, the apparent density requirement could not be met. ■ Laboratory tests proved that the Buell Classifier could easily meet the mesh requirements, and the required apparent density could be maintained if the classification was at 95% overall efficiency. The Buell Classifier simply discharged the coarse sodium phosphate by gravity into one bin and carried the fine material by air to a second bin. ■ Despite rigid particle-size requirements, Buell Air Classifying Systems operate to critical size specification at well over 90% efficiency. High capacities let them keep up with all mills. And with low velocity and no moving parts, wear is almost non-existent. ■ Buell Classifiers today are being used in iron ore beneficiation, removal of minus 10 micron sodium nitrate particles, dedusting of soda ash and the classification of such diverse materials as phosphate rock, silicon carbide, uranium ore and glass beads. Many installations have proved so successful that they have led to repeat orders. Why not send us your specific problem? Write for descriptive literature. The Buell Engineering Co., Inc., Dept. 12-I, 123 William St., New York 38, N. Y. Northern Blower Division, 6411 Barberton Ave., Cleveland, Ohio. (Subsidiary: Ambuco, Ltd., London, England) ■ Cyclones • Electric Precipitators • Bag Collectors • Combination Systems • Classifiers

Y news briefs

from **Yarnall-Waring Company,** *Philadelphia 18, Pa.*

BRANCH OFFICES IN 19 UNITED STATES CITIES • SALES REPRESENTATIVES THROUGHOUT THE WORLD
STEAM TRAPS STOCKED AND SOLD BY 270 LOCAL INDUSTRIAL DISTRIBUTORS

USE THIS YARWAY STEAM TRAP TO KEEP YOUR DRYERS, COOKERS, TANK COILS AND OTHER PROCESSING EQUIPMENT OPERATING AT PEAK EFFICIENCY

Valve literally "floats on condensate load"

Yarway Series 60 Impulse Steam Traps are the traps "designed with high production in mind." They get processing equipment hotter, sooner—and keep it hot. Here's how:

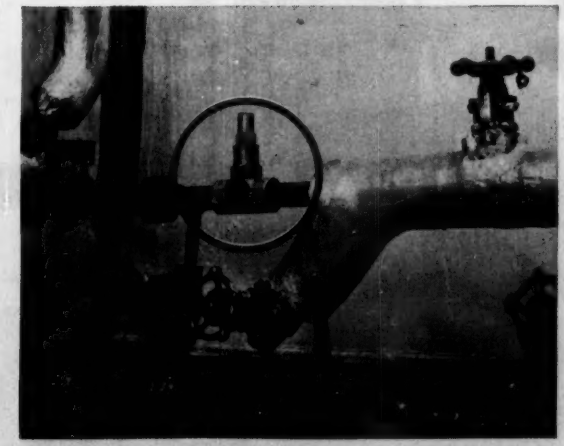
The only moving part, a small stainless steel valve, literally "floats on the condensate load." When equipment is started up, and condensate load is heavy, it opens wide and discharges at full capacity to bring equipment to operating temperature as quickly as possible.

In operation, it continuously senses condensate temperature, discharging each bit of condensate as it forms instead of storing up a bucketful. Result—higher temperatures, more even temperatures, more productive equipment.

Other Yarway features—small size, light weight, good for all pressures, low maintenance, stainless steel.

Yarway pioneered the impulse trap with its unique thermo-dynamic principle over 25 years ago. Most users find among Yarway's full line of impulse traps the profitable and productive solution to their steam trapping problems—you can too!

You can get Yarway's latest steam trap Bulletin T-1743, or a free 60-day trial of any Yarway Steam Trap, by writing Yarnall-Waring Company or contacting your local Industrial Distributor.



¾" Yarway Impulse Steam Trap draining tank coils on sulfur storage tank, 175 lbs. pressure

YARWAY OFFERS IMPULSE STEAM TRAPS FOR THESE SPECIFIC OPERATING CONDITIONS

AVERAGE CONDENSATE LOADS	EXTRA HEAVY CONDENSATE LOADS	LIGHT CONDENSATE LOADS
Series 60	Series 40	No. 30

Kellogg Plant Engineering Goes to Work for SunOlin

Now in operation at North Claymont, Delaware, SunOlin Chemical Company's new urea plant, below, is a working replica of the model shown above, which Kellogg built and used in engineering and erecting the project. Utilizing the Fauser-Montecatini Process, this plant is the first major urea plant on the East Coast—and produces over 200 tons per day of crystalline and prilled urea.

A major feature of the plant is the Kellogg-designed steam-methane reformer, which produces the 150 tons of CO_2 required each day for reacting with 120 tons of NH_3 to form the ammonium carbamate which is dehydrated to urea and water. Much of this water is used to absorb unreacted NH_3 and CO_2. These reactants are then returned to the reactor for re-use.

Kellogg welcomes the opportunity to discuss its engineering-procurement-construction services with you, and to show you how its model techniques can expedite plant design and completion.

THE M. W. KELLOGG COMPANY

711 Third Avenue, New York 17, N.Y.

A subsidiary of Pullman Incorporated

Offices of other Kellogg companies are in Toronto, London, Paris, Rio de Janeiro, Caracas, Buenos Aires

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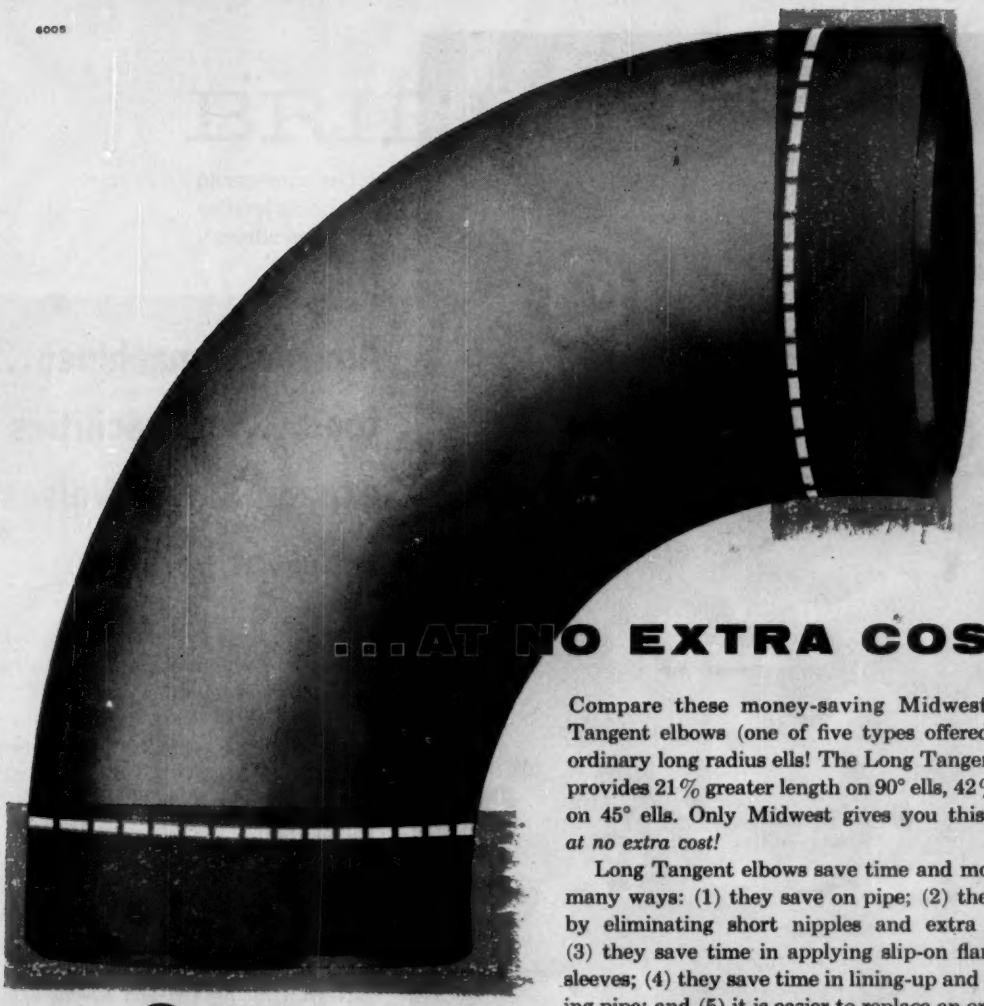


...AT NO EXTRA COST!

21% MORE ELBOW

Compare these money-saving Midwest Long Tangent elbows (one of five types offered) with ordinary long radius ells! The Long Tangent type provides 21% greater length on 90° ells, 42% more on 45° ells. Only Midwest gives you this bonus *at no extra cost!*

Long Tangent elbows save time and money in many ways: (1) they save on pipe; (2) they save by eliminating short nipples and extra welds; (3) they save time in applying slip-on flanges or sleeves; (4) they save time in lining-up and clamping pipe; and (5) it is easier to replace an ordinary ell with a Midwest Long Tangent than with another ASA ell.

Only Midwest manufactures and stocks Long Tangent ells in a complete size range through 36". Also available with special tangent lengths at slight additional charge.

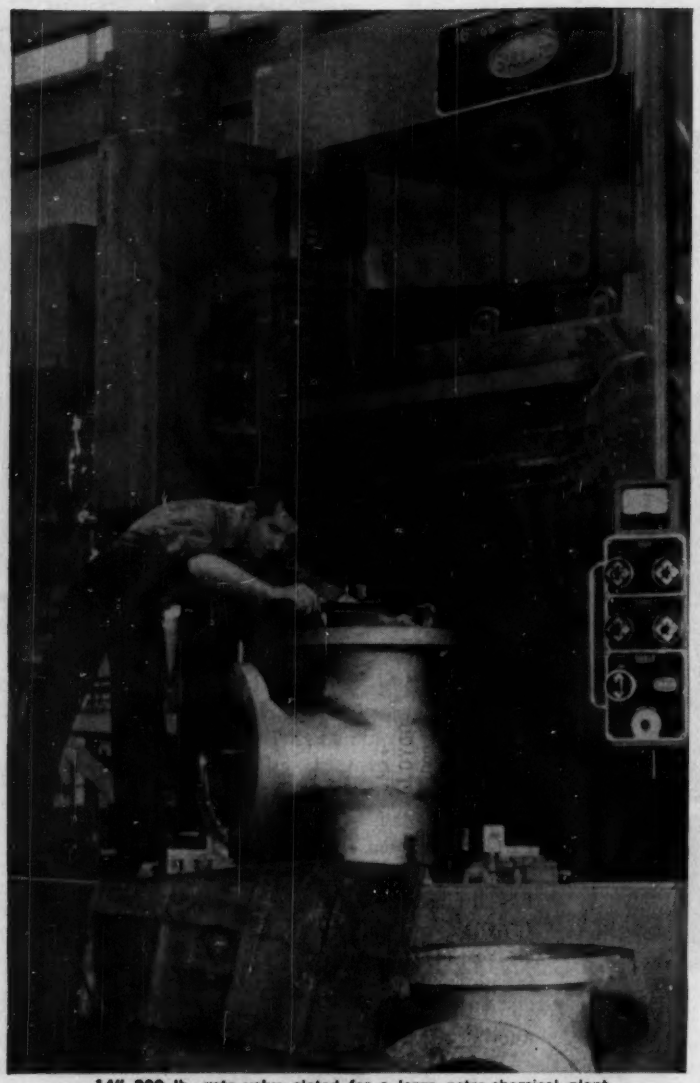
Write for catalog which shows complete selection of Midwest welded-type and seamless fittings.

Sold through Stocking Distributors from Coast to Coast

MIDWEST

MIDWEST PIPING COMPANY, INC.
1450 S. Second Street St. Louis 4, Missouri

THE WORLD'S MOST COMPLETE LINE—
SEAMLESS AND WELDED-TYPE FITTINGS



14" 300 lb. gate valve slated for a large petro-chemical plant, is being worked on one of Aloyco's battery of new Bullards.

Advanced machines... tools...test facilities expand Aloyco Valves' range of service

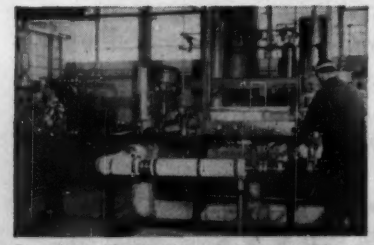
Constant change and improved techniques in modern fluid handling, pose a real challenge for valve manufacturers.

To meet these demands, Aloyco is constantly adding new facilities, some of which are pictured here.

For example, Aloyco Stainless Steel Valves are now available in sizes up to 24", pressures up to 2,500 lbs. at 650°F.

While these new facilities have improved and expanded the quality and usefulness of our entire line, they are particularly important, for example, in the manufacture of valves for the nuclear and missile fields.

For advanced knowledge and ideas plus the equipment to carry them out—take your next valve problem to the specialists: Alloy Steel Products Company, 1301 West Elizabeth Avenue, Linden, New Jersey. o.e



One of finest hot test loops in the nation checks out valves at up to 2500 psi, 650°F. Hot tests can spot trouble that would otherwise be revealed only after months of line service.

New multimillion dollar Aloyco plant combines new production tools, test facilities, sales, administration, research and development offices and labs into single integrated unit.

Boroscope examination (in pressurized clean room) of specially made nuclear valves follows the application of dye penetrant.

ALLOY STEEL PRODUCTS COMPANY

LINDEN, NEW JERSEY

Boston • New York • Wilmington • Atlanta • Birmingham • Baton Rouge • Buffalo
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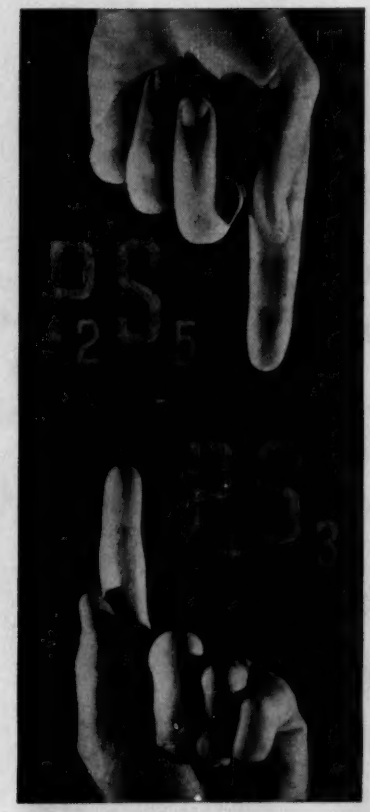
BRIEFS

phosphorus sulfides
sulfuryl chloride
muriatic acid



HOOKER OFFERS TWO OF THE FOUR

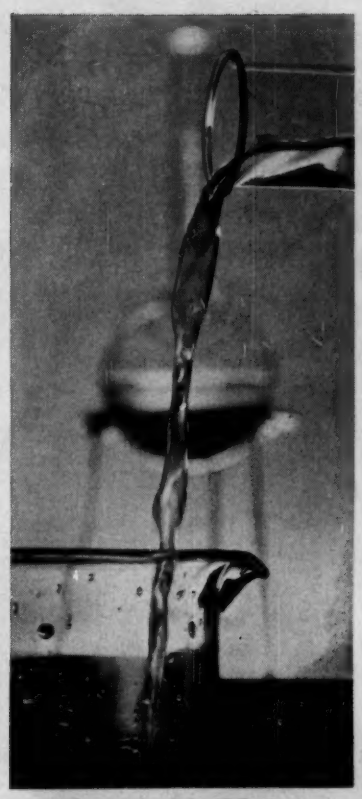
According to the Encyclopedia of Chemical Technology, only four of the 14 phosphorus-sulfur compositions are true chemical entities. We offer two of them: phosphorus sesquisulfide (P_4S_3) and phosphorus pentasulfide (P_2S_5). Both have wide use as reagents in organic synthesis. We provide the pentasulfide as a grey-yellow material fused solid or as a powder in three mesh sizes. It has a typical melting point of 278°C. Our phosphorus sesquisulfide is a lemon-yellow powder with a typical melting point of 171°C. It contains no free phosphorus. Write for complete data sheets on both.

WHAT THEY SAID IN 1944

A technical paper in the September, 1944 issue of *Industrial and Engineering Chemistry* predicted great things for a relative newcomer on the reagent scene, Hooker sulfuryl chloride. It said:

"Sulfuryl chloride is a versatile reagent with great potentialities in organic synthesis. Under appropriate conditions it may be used for the chlorination and sulfonation of both aliphatic and aromatic derivatives. It may also be applied as an acylating and condensing agent. The simplicity of these reactions, their ease of control and their high yields promise to make the reagent particularly useful in many applications which require simple and unspecialized equipment."

What was said in 1944 is just as true today. For a reprint of this comprehensive technical article and our technical data sheet, check coupon below.



BETTER ADBSORPTION WITH HCL

Now they're activating clay with muriatic acid instead of the cheaper sulfuric acid. Reason: 25% to 75% higher decolorizing efficiency of the resulting clays. Chloride salts produced in the digestion step are more soluble than sulfites produced by H_2SO_4. The new process is a boon to lube oil producers, vegetable oil refiners and manufacturers of catalysts. Our authority for this is *Chemical Engineering*, January 12, 1959, page 62.

Since Hooker is a major producer of muriatic acid, we look with great favor on any new process that involves substantial tonnages of this product. We produce two grades, commercial and Hooker white, both arsenic-free and of exceptional purity. Our data sheet No. 720-B will be sent on request.

For more information, check here and mail with name, title and company address:

- ☐ Phosphorus pentasulfide, data sheet
- ☐ Phosphorus sesquisulfide, data sheet
- ☐ Muriatic acid, data sheet
- ☐ Sulfuryl chloride, reprint and data sheet

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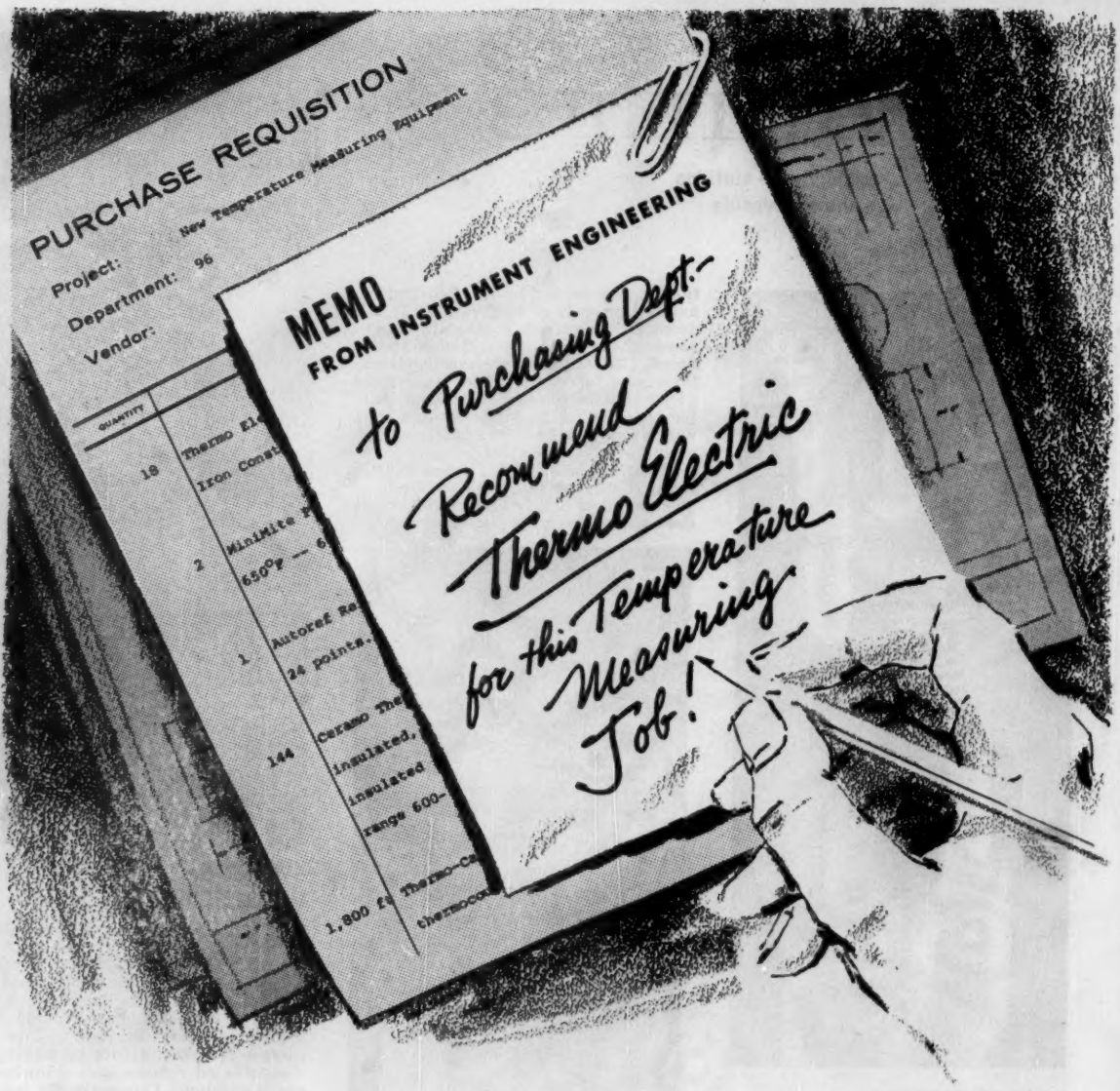

Every industry has its pacemakers, who, through superior engineering know-how and application, build a reputation for unexcelled product quality and customer service. Today, Thermo Electric Co., Inc. is setting the pace, and has the reputation for high quality standards in temperature measurement equipment.

Why Should You Insist on Thermo Electric Quality Temperature Measuring Equipment?

—Because every piece of Thermo Electric equipment is guaranteed to give you sensitivity, fast response with consistent accuracy over a longer useful life. In all system components—indicating, recording, controlling instruments, monitors, wire, connectors, thermocouples, etc.—Thermo Electric maintains high manufacturing and quality standards. Basic materials and parts are subjected to intensive field and laboratory testing before being selected for use in Thermo Electric products. Even in packaging, there is no compromise with quality, since that one departure could nullify all previous controls. This emphasis on quality pays dividends to you! They are—improvements in your product or service quality level, fewer rejects, lower manufacturing costs, lower maintenance and replacement costs.

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Just as a good chef wouldn't use only one all-purpose spice to make a specialty...we don't make an electric motor with one all-purpose insulation.

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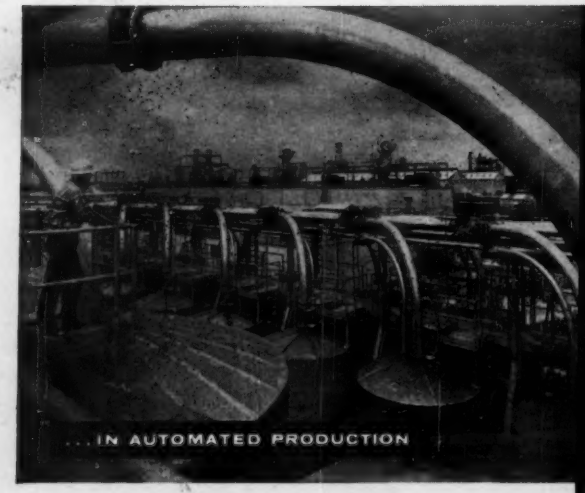
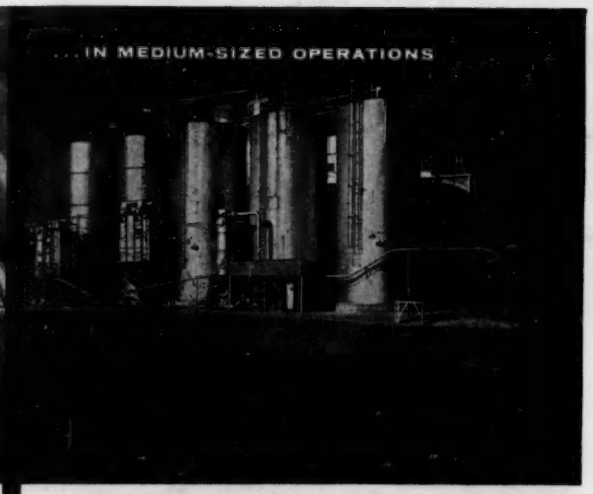
A MAJOR INDUSTRIAL COMPONENT OF
FAIRBANKS WHITNEY CORPORATION



...IN AUTOMATED PRODUCTION

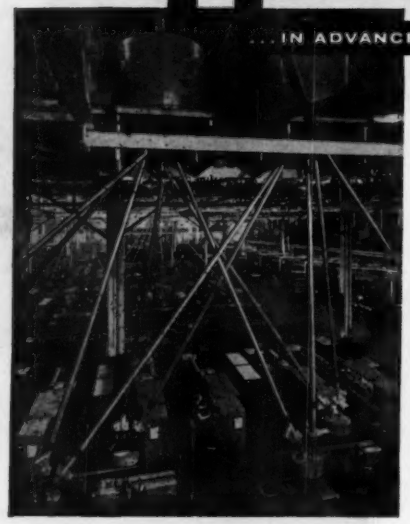
Airstream Conveyor Systems automatically handle polyethylene throughout all phases of production — drying, extruding, pelletizing, storage and bagging — at Phillips Chemical Co., Pasadena, Texas. High-volume, high-purity Dracco systems like this are used by most major plastics producers.



...IN MEDIUM-SIZED OPERATIONS

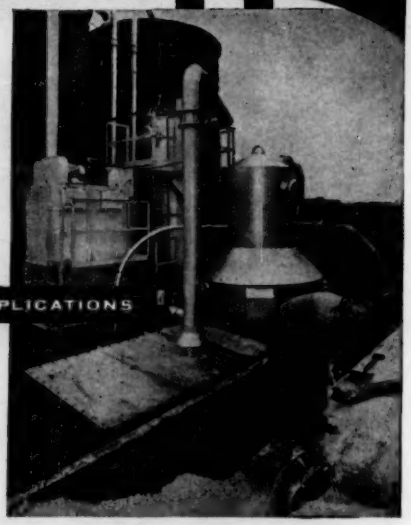
Typical unloading-to-storage-to-process systems, like this one at St. Louis feed supplement plant of Merck & Co., enable bulk materials users to take best advantage of other modern production techniques and equipment. Such systems are easily expanded, with minimum engineering cost, when handling requirements increase.

Dracco ***experience*** *gives you pneumatic conveying at its finest!*



...IN ADVANCED PROCESSING

Automatic in-plant materials distribution with Airstream Conveyors enables Western Electric Co. to apply new cable insulating and sheathing methods at Point Breeze Works, Baltimore. Systems carry 11 different colors of polyethylene pellets over distances up to 700 feet, supplying 50 extruding machines without contamination or intermixing.

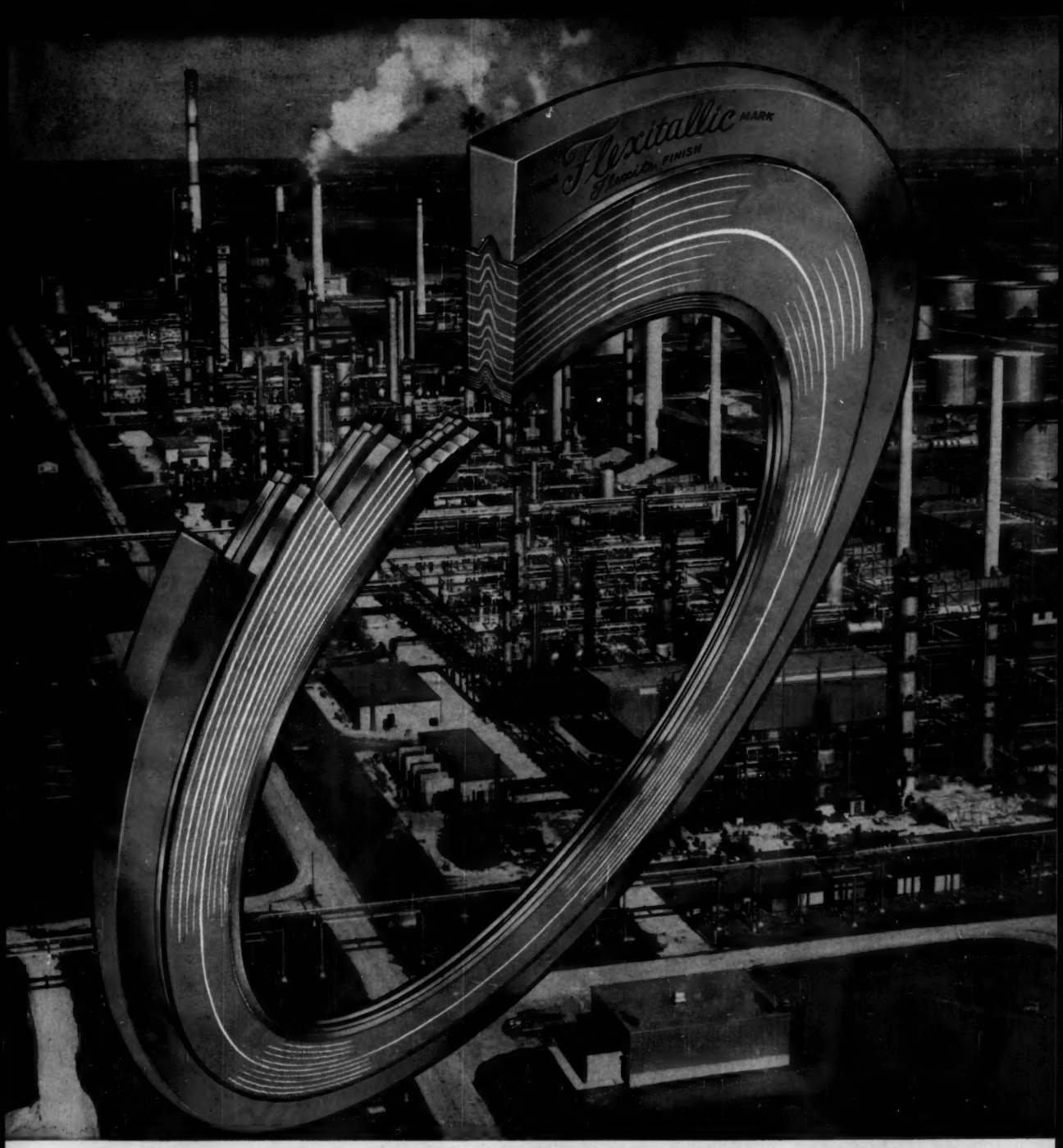


...IN SMALL-QUANTITY APPLICATIONS

Airstream Conveyors prove economical in handling quantities as small as one carload a month, or the equivalent. This low-cost, ground-level system at a mid-western processing plant is used only periodically to unload lime from trucks to storage, yet provides important savings in materials and labor costs.

Whether your dry materials handling requirements are large or small, simple or complex, it pays to install an air conveyor engineered by experienced specialists. To be sure you get the system best suited to your application, contact: Dracco Division of Fuller Co., Harvard Avenue and East 116th Street, Cleveland 5, Ohio.

DRACCO *airstream* conveyors
dust control equipment



End corrosion in gasket inventory

The gold Flexite Finish* for the metal gauge rings in Flexitallic Compression-Gauge Gaskets is new. It is highly corrosion resistant when exposed to severest weathering in open construction projects or in stock. The Flexite Finish provides for ease of identification and a clean, long-lived installation. Write for samples.

FLEXITALLIC GASKET CO., 8th & Bailey Sts., Camden 2, N. J.
Representatives in Principal Cities

TRADE Flexitallic® MARK
SPIRAL-WOUND GASKETS
WITH Flexite FINISH

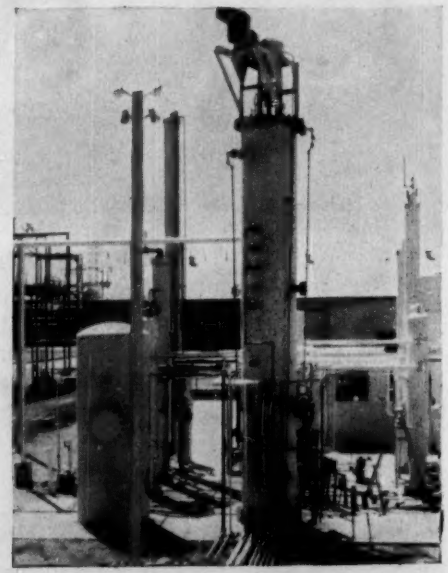
*The gold Flexite Finish is a development of the Flexitallic Gasket Co. (Originators of Spiral Wound Construction) — Register applied for on both name and color. Flexitallic Blue is our exclusive blue-dyed Canadian asbestos filler. Look for the blue and gold color combination as the mark of Flexitallic quality.

13 COOPERATING COMPANIES* SELECT GENERAL AMERICAN RDC COLUMN FOR PROTOTYPE PLANT

Lignite low temperature tar is a relatively new and unknown raw material. To determine its potential value, a cooperative research program was started by 13 companies in 1954 at the Battelle Memorial Institute.

One of the important developments has been a solvent extraction process . . . a countercurrent extraction of this tar with 75% methanol—25% water and commercial hexane . . . using the RDC column. The development appeared so promising that a prototype plant was constructed at Alcoa's Rockdale Works by Texas Power & Light Company incorporating a General American RDC pilot column. *Only* the RDC column combines all these advantages: High volumetric efficiency, high throughput capacity, elimination of interstage settling, flexibility for changing feed conditions, lower power requirements, simple construction, tolerance for solids.

For any applications dealing with liquid-liquid, liquid-solid, liquid-slurry extraction . . . why not get full information on a General American RDC column? (Write for Bulletin #T-1159) Remember, *it pays to plan with General American.*



Process Equipment Division—Turbo-Mixers

GENERAL AMERICAN TRANSPORTATION CORPORATION

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TURBO-MIXER GENERAL AMERICAN TRADE MARK

*Names on request

EXCLUSIVE RDC LICENSEE IN THE PROCESS INDUSTRY

Textile Technology in Chemical Engineering

Fiber selection and its importance in filtration

At the very inception of filter fabric design, the key decision that must be made is the selection of the textile fiber or combination of fibers. Both natural and man-made fibers play a major part in filter fabrics.

Each of the many fibers has its own peculiar attributes to fulfill the different filtration requirements.

The natural fiber, cotton, offers the advantages of bulk, plus the high wet strength especially important in filtration. It is a relatively low cost material.

Filter press cloths made of filament yarns such as nylon have a slick, smooth surface for greater ease in cake discharge. Nylon also has excellent caustic resistance and outstanding physical properties.

Acrylic fibers have a high degree of acid resistance, good strength, and resistance to other chemicals and destructive organisms such as mildew and bacteria.

The characteristics of these and many other fibers are strong considerations in making the proper choice. All their properties, however, do not necessarily carry over automatically into the finished fabric. Fabric performance, regardless of fiber, is finally determined by the actual construction of the cloth.

To get *complete* information about filter fabrics, make sure you consult a specialist. The specialists who distribute Wellington Sears filter fabrics are fully equipped to help you select the medium that best answers your problems. Behind them, they have our 114 years of experience in providing quality fabrics to industry. For distributors' names, and a handy information booklet, write Dept. M-6.

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FIRST In Fabrics For Industry

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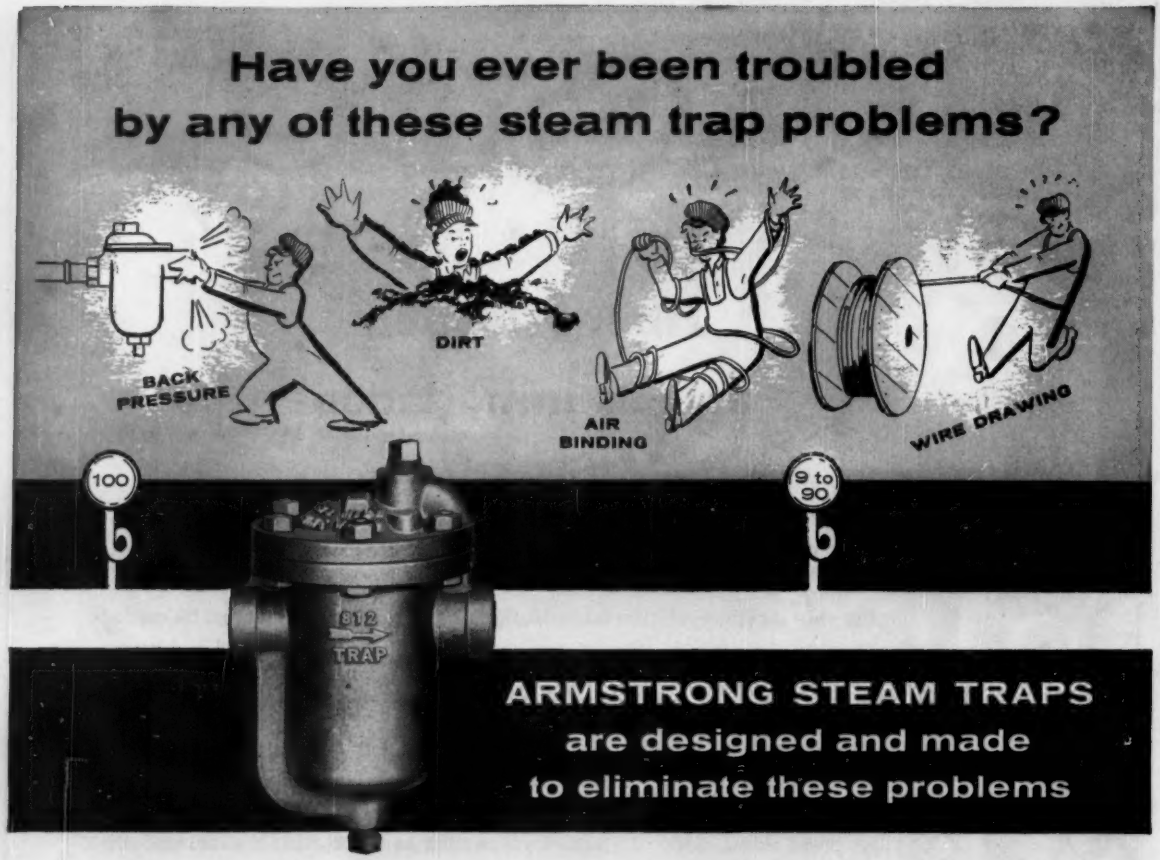
Have you ever been troubled by any of these steam trap problems?



BACK PRESSURE . . . Armstrong Traps operate on any back pressure—or vacuum, for that matter. As long as there is a pressure differential across the trap, it will close on steam and open for condensate. Even the high back pressure caused by blow through of one or more traps in the system will not disturb Armstrong Traps. Other than a reduction in capacity, Armstrong Traps are unaffected by back pressure.

DIRT . . . Armstrong Traps are not affected by ordinary dirt. When the trap opens condensate swirls down under the edge of the bucket and up through the discharge orifice. Dirt is kept in suspension and discharged along with the condensate. For very bad dirt conditions, Armstrong offers traps with integral strainers. These cost less than a trap plus a separate strainer.

AIR BINDING . . . Armstrong Traps cannot air bind. Air in the system passes through a vent in the top of the bucket. It collects in the top of the trap and is discharged with the condensate. There is no chance for it to stop the trap. For low pressure on-and-off units where large amounts of air accumulate while the steam is off, Armstrong offers open float and thermostatic air vent traps in a complete range of sizes.

WIRE DRAWING . . . Armstrong Traps are designed and made to resist wire drawing. The valve and seat are tough stainless steel. The valve opens and closes tightly with a fast action and is always water sealed. There is virtually no chance for grit or sediment to lodge in the valve, virtually no chance to create conditions that lead to wire drawing.

There's no need to accept any of these problems as "inevitable." Your local Armstrong Representative can show you how to end them all. Call him today or write direct.

860 Series for low pressure heating service.

800 Series, side inlet, side outlet.

No. 801, side inlet, bottom outlet.

880 Series, integral strainer.

200 Series, bottom inlet, top outlet.

Forged Steel Series for high pressures, high temperatures.

The 48 page Armstrong Steam Trap Book tells how to correctly size, install and maintain steam traps for any pressure, any temperature, any load plus full catalog data on Armstrong Steam Traps. Ask for Catalog K.

ARMSTRONG MACHINE WORKS

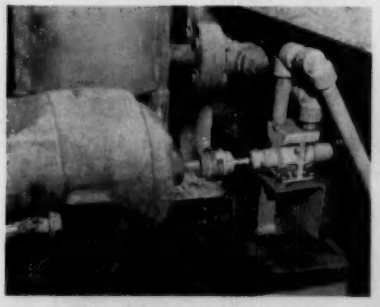
8585 Maple Street, Three Rivers, Michigan

"See our catalog in Chemical Engineering catalog"

ECO ENGINEERING NEWS

the big name in small pumps for the process industries

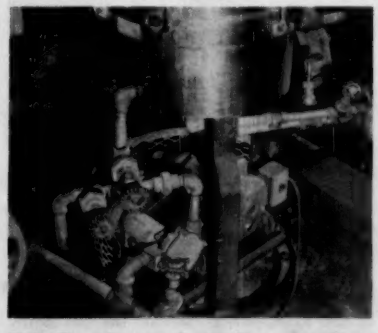
Seven Years Hard Service Only Repair, Seal Replacement



True Brite Chemical Products Co., Oakville, Conn., producers of sodium and potassium copper cyanides and other essentials for metals finishing, are long-time users of Eco Pumps.

Their satisfaction stems from such performances as that of the Eco ALL-CHEM pump pictured above, pumping sulphates and dilute sulphuric acid to a rotary vacuum filter. In seven years of continuous intermittent service, the only attention required has been a replacement of the gland packing.

This 316 stainless steel pump has now been relieved by another Eco ALL-CHEM (True Brite keeps replacements on hand for each Eco pump in case of emergency need), while the old pump is being equipped with new Teflon† interchangeable rotors and sleeve bearings, ready for another seven years of trouble-free service.



This Eco CENTRI-CHEM Pump at True Brite feeds sodium copper cyanide (double salts) to one of the dryers employed in this plant. All filters and dryers are Eco pump equipped and, according to President Henry Strow, they have been found to be the best pumps available for the services involved.

†du Pont Trade mark

Eco Pumps Protect Clarity, Color and Un-contaminated Purity of Pharmaceuticals

Pharmaceutical Industries, Inc., Merchantville, N. J., ship world-wide such products as Liposal for treating infantile eczema and asthma; Polymul, an infant fat modifier; and Donic for reducing cholesterol—a "heart-felt" blessing to many of us.

Employ Nitrogen Atmosphere

The preparation of these pharmaceuticals requires extremely exacting processing, since they are made from highly unsaturated vegetable and marine oils which are very oxygen labile.

Processing is carried on in a nitrogen atmosphere of about 2 psi above normal atmosphere.

Both Eco ALL-CHEM Pumps and GEARCHEM Pumps of 316 stainless steel with Teflon trim and gland seals are used to handle the component materials and the finished products—which are packaged in transparent individual dispensules revealing color and clarity of dosage.

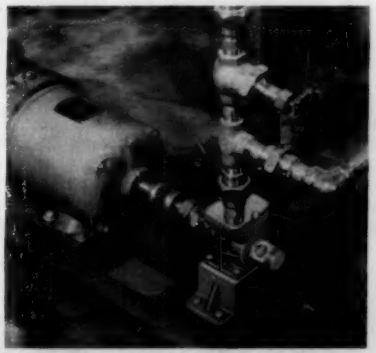
Four Years "Uneventful" Service

The two Eco ALL-CHEM Pumps, illustrated above, have handled more than a quarter million gallons of oxygen labile pharmaceuticals during the past 4 years of uneventful continuous service.

Pumps Very Satisfactory

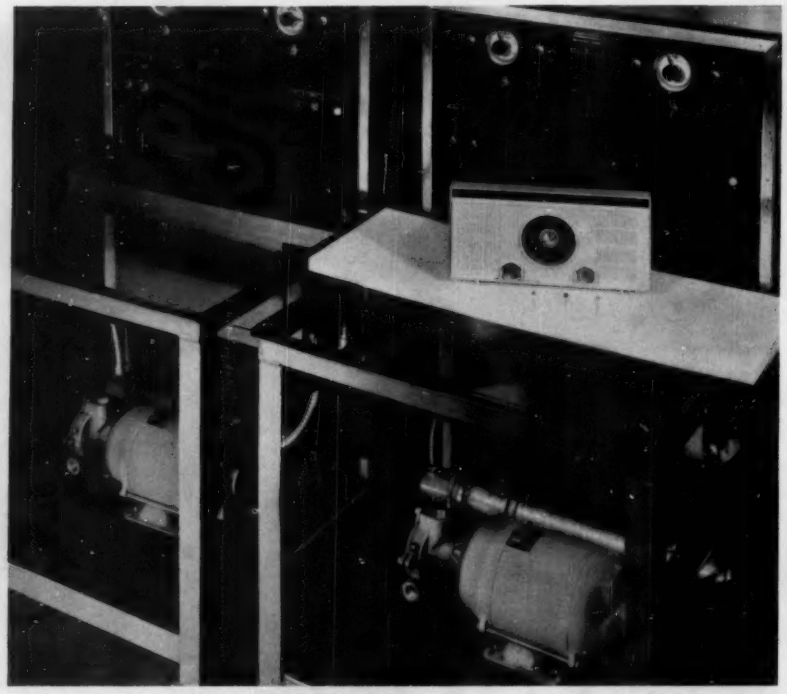
"These Eco Pumps have proven very satisfactory," says Dr. Worne of Pharmaceutical Industries. "They provide beautiful suction lift where required, offer no contamination problem either from air ingress into the system or from materials of construction, and supply continuous, linear flows most suitable to our needs."

"We now have standardized on Eco Pumps —following an early unfortunate experience with centrifugals of another make."



Close-up of one of the Eco ALL-CHEM 1750 rpm direct motor driven units at Pharmaceutical Industries, Inc.

"BEST PUMPS IN THE PLANT", *Say Sylvania Maintenance Men*



New Sylvania Production Units for processing Radio Transistors, being equipped with Eco CENTRI-CHEM Pumps

This is a story of pump economics. Sylvania Electric Company, Division of International Telephone and Telegraph Company, were using an inexpensive make of pumps in recirculating systems containing dilute hydrogen peroxide in warm water. However, low first cost was soon offset by extensive maintenance and expensive loss in production time.

Studied Advantages

Sylvania and Eco engineers discussed in detail the advantages of high nickel alloys and Teflon-ceramic mechanical seals, as used in the Eco CENTRI-CHEM centrifugal before trying out the first Eco pump.

Results Pay Off

The savings were apparent from the beginning as there have been no pump breakdowns or replacement parts required, no interruptions of production—although these pumps operate twenty-four hours a day, six days a week, and some of them have now been in service for more than 2 years.

Successful pump installations don't just happen. They are planned. This typical Eco success story highlights two important advantages of doing business with Eco—good products and close cooperation between Eco and customer engineers to insure sound application economics.

Standardize on Eco

Sylvania now standardizes on Eco CENTRI-CHEM Pumps for all similar pump requirements in their multi-plant complex and Sylvania maintenance men refer to them as, "The best pumps in the plant."

ECO Products for Handling Corrosive and Hazardous Processing Fluids

ALL-CHEM® Rotary Pumps
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CENTRI-CHEM® Centrifugal Pumps
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CHEMICAL DISPENSING VALVES
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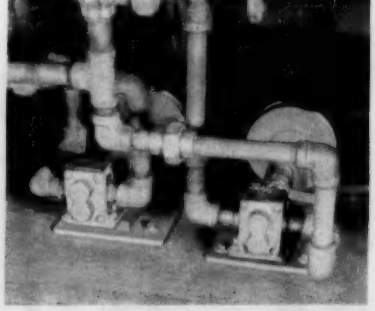
Circulating Caustic and Nitric Acid Baths in Wire Finishing



Side by side, these two identical GEARCHEM Pumps, sharing the same motor, pump media at opposite ends of the pH scale, simultaneously. They are 316 stainless steel, equipped with Hastelloy*C gears for corrosion resistance in both acid and caustic environments, and also to withstand the abrasion of fragments of metal remaining from the wire drawing operations, which accumulate in the baths.

*T.M. Union Carbide Corp.

DAWN OF A NEW ERA IN INDUSTRIAL PROCESS CONTROL

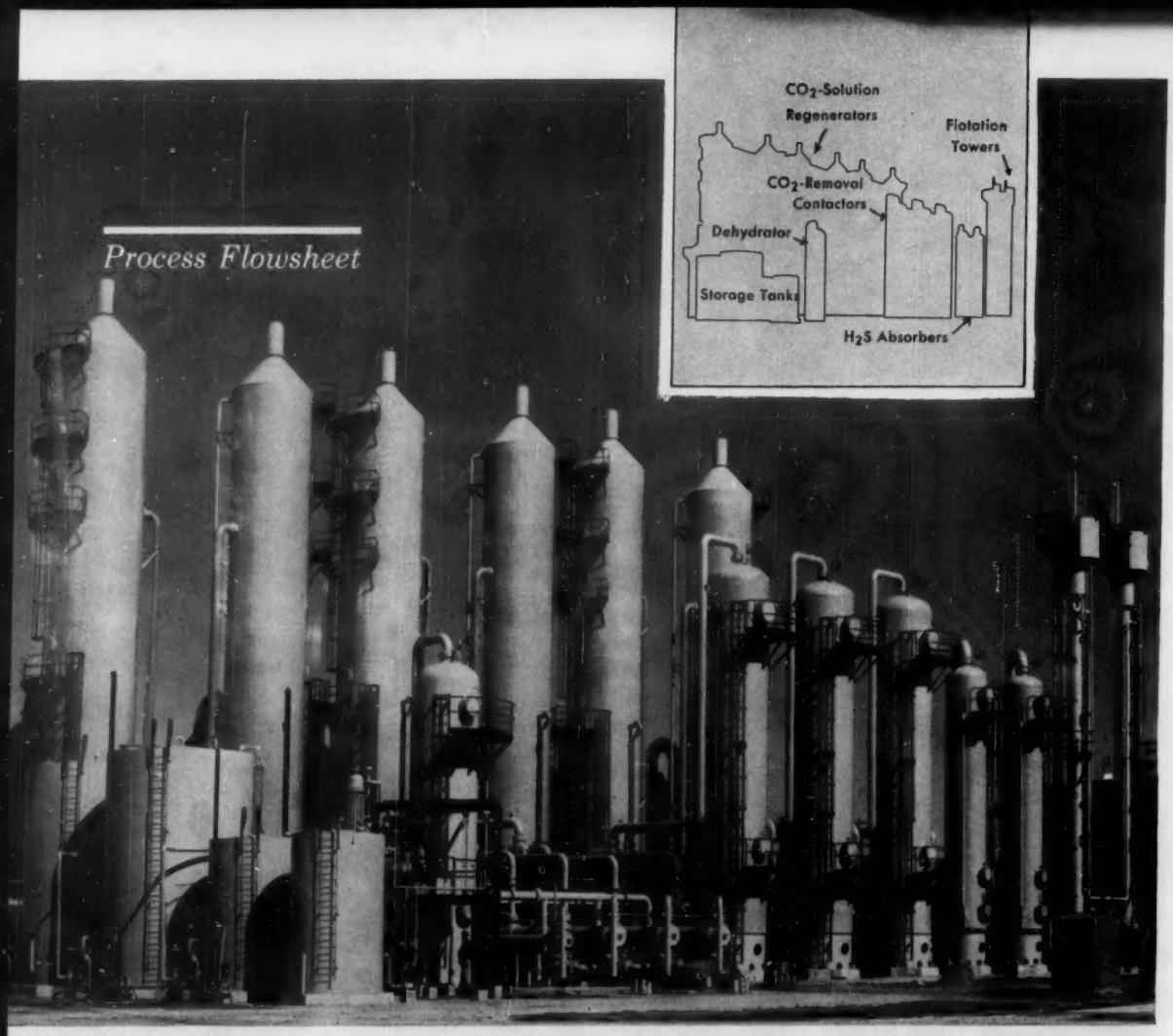
introducing the first
computer system fully mated
to industrial process control....THE LIBRATROL 1000

Now for the first time your process control system can benefit from a transistorized digital computer totally designed for the modern industrial processing plant... the new, solid-state LIBRATROL*-1000. A distinguished new product of Librascope, manufacturer of the most varied line of computers in use today. Dozens of features make this the computer most likely to accelerate the current revolution in process control. **WHY THE LIBRATROL-1000 EXCELS AT INDUSTRIAL PROCESS CONTROL:** PACKAGING FEATURES...Sealed and refrigerated for long service life and reliability. Engineered for vibration resistance and ease of maintenance. INPUT-OUTPUT FEATURES...Quick-access loop speeds input of transducer data and output of commands to actuators. Numbers of transducers and actuators that can be accommodated are unlimited by hardware. OTHER IMPORTANT FEATURES...Sequencing is changeable by program. Complete random sequence, fixed sequence, or single channel. 8000-word memory. **ONLY LIBRASCOPE OFFERS CHOICE OF TWO COMPUTER SYSTEMS**...The LIBRATROL*-500 is a versatile but less expensive system... ideal for helping you develop a program of long-range conversion to automatic control...or for fully handling on-line situations not requiring all features of the LIBRATROL-1000. Either is available on a variety of purchase or lease arrangements. **CAN THE NEW ERA IN AUTOMATIC PROCESS CONTROL MEAN SIGNIFICANT IMPROVEMENTS IN YOUR COMPANY'S OPERATION?** *Find out. Write for the new Libratrol brochure with specifications and operating information. Or better still, request consultation now with a Librascope Systems Engineer versed in the control requirements of your industry.*

*TRADEMARK, GENERAL PRECISION, INC.

LIBRASCOPE DIVISION **GENERAL PRECISION,** INC.
Glendale 1, California

Computers that pace man's expanding mind



Sweet-Gas Process Makes U.S. Debut

Much-touted Giammarco-Vetrocoke process proves its worth in new Texas plant, effectively scrubbing CO_2, H_2S from natural gas.

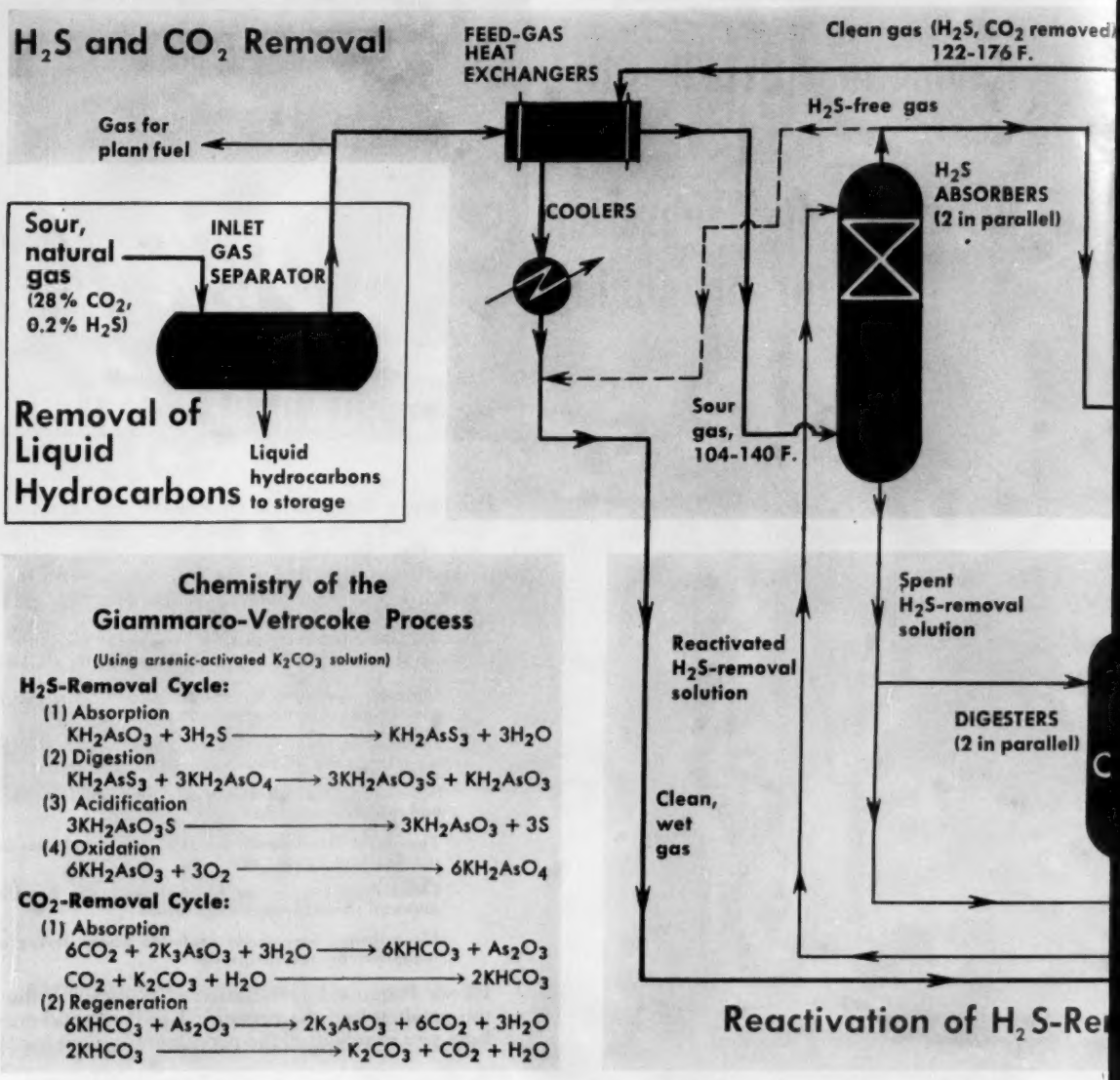
When Transwestern Pipeline Co. began sending Texas natural gas to California consumers through its new 1,800-mi. pipeline this summer, the event marked a big "first" in U. S. chemical processing—commercial operation of the first plant in the Western Hemisphere to sweeten gas by the Italian-developed Giammarco-Vetrocoke process.

Transwestern's new G-V plant, about 35 mi. from Fort Stockton, Tex., is in the Puckett gas field, where one branch of the firm's new line begins. Built by Brown & Root, Inc., the installation is the largest of the 20-odd G-V plants throughout the world. It can sweeten 180 million scfd. of Puckett-field output before the gas enters the line, reducing CO_2 content from 28% to under 2% and removing essentially all of the gas's 0.2% H_2S.

▶ **What It Is**—The G-V process, based on patents held by Vetrocoke, Sp.A. of Marghera, Italy, removes CO_2, H_2S from gas by treating it with potassium or sodium carbonate solutions activiated by salts of multivalent metals (such as arsenic) or by undisclosed organic compounds. Solutions are regenerated by blowing with air or steam.

The process can treat a wide variety of gas streams. It boasts utility requirements substan-

Unfold Flowsheet



Chemistry of the Giammarco-Vetrocoke Process

(Using arsenic-activated K_2CO_3 solution)

H_2S-Removal Cycle:

(1) Absorption

$$KH_2AsO_3 + 3H_2S \longrightarrow KH_2AsS_3 + 3H_2O$$

(2) Digestion

$$KH_2AsS_3 + 3KH_2AsO_4 \longrightarrow 3KH_2AsO_3S + KH_2AsO_3$$

(3) Acidification

$$3KH_2AsO_3S \longrightarrow 3KH_2AsO_3 + 3S$$

(4) Oxidation

$$6KH_2AsO_3 + 3O_2 \longrightarrow 6KH_2AsO_4$$

CO_2-Removal Cycle:

(1) Absorption

$$6CO_2 + 2K_3AsO_3 + 3H_2O \longrightarrow 6KHCO_3 + As_2O_3$$

$$CO_2 + K_2CO_3 + H_2O \longrightarrow 2KHCO_3$$

(2) Regeneration

$$6KHCO_3 + As_2O_3 \longrightarrow 2K_3AsO_3 + 6CO_2 + 3H_2O$$

$$2KHCO_3 \longrightarrow K_2CO_3 + CO_2 + H_2O$$

tially lower than those of competitive routes, even when steam blowing is used. The treating solutions won't corrode carbon steel, are unaffected by contaminants such as oxygen, cyanides or tars, and do not undergo degradation from side reactions.

▶ **Specifics**—For H_2S removal, metallic-salt-activated solution can be used if inlet gas H_2S level is under about 1.5% and sulfur to be removed is under 15 tons/day. The solution will lower H_2S content to under 1 ppm., can handle gas as low as 1 atm. and as hot as 300 F., and can selectively remove the sulfide from feed also containing CO_2. Solution is regenerated by air blowing; sulfur is recovered in elemental form.

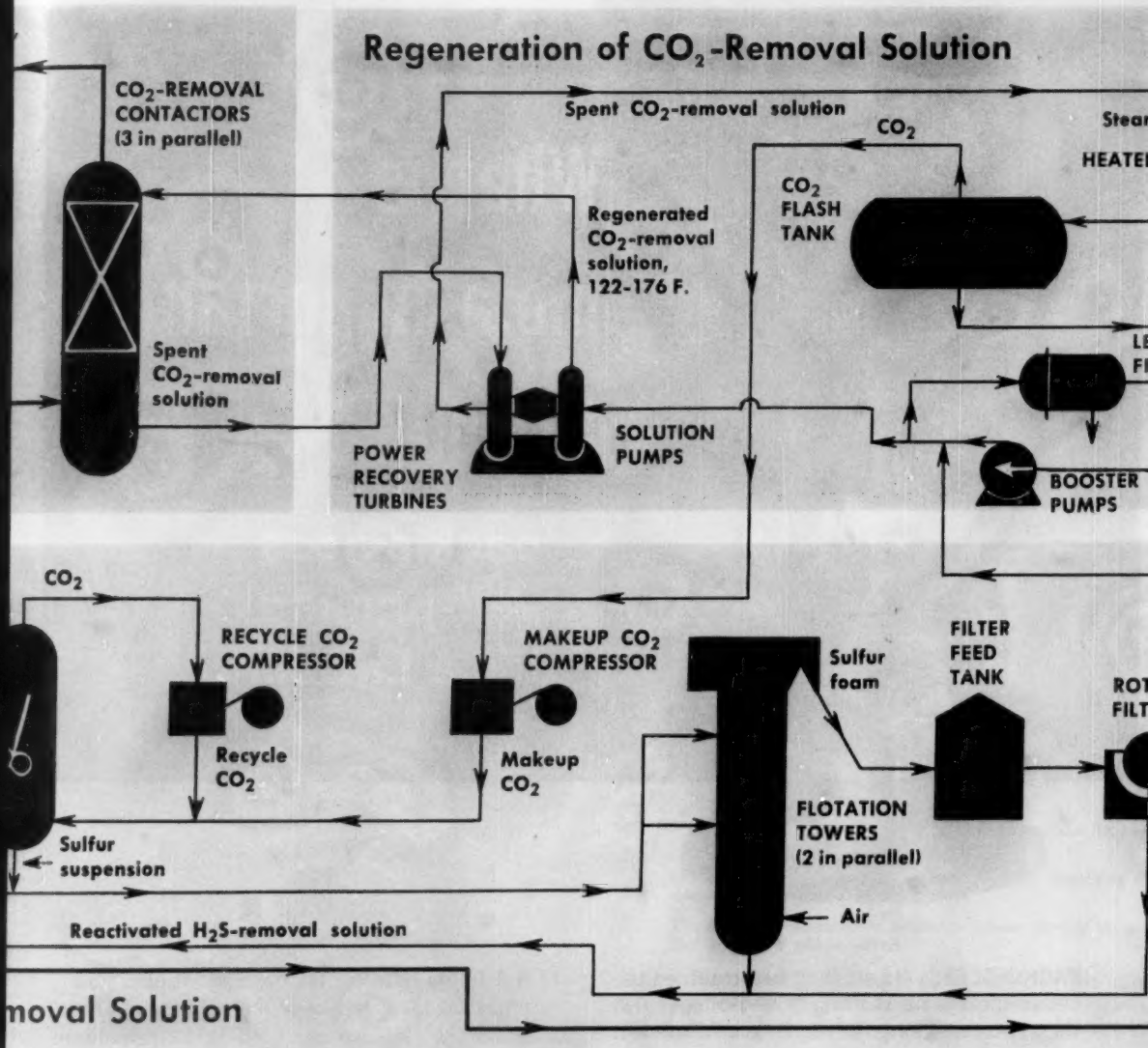
With higher H_2S level or more sulfur to be removed, organically activiated solution is used. This system doesn't exhibit such effective cleanup, selectivity or temperature resistance, but features the general G-V process advantages cited above.

The G-V route can economically lower CO_2 content to 0.05%, can selectively extract the gas from a mixture also bearing H_2S. CO_2 can be recovered 99+% pure (with under 1 ppm. H_2S) by air or steam blowing; when steam is used, over 99% of the absorbed CO_2 can be recovered, at pressures up to 150 psig.

▶ **Chemistry**—Key to all these features lies in the solution activators. Organic activator acts essentially as a catalyst, and gas removal mechanism is the same as with carbonate solution alone—but more effective in operation.

The metallic-salt activators, on the other hand, enter into the removal reactions. Idealized reactions, using arsenic-activated K_2CO_3 solution for illustration, are shown in the box above.

▶ **At Transwestern**—Transwestern uses its new



G-V plant to remove both CO_2 and H_2S, employs undisclosed metallic salts as activators, and regenerates its solutions with air. Brown & Root designed the facility with parallel trains of equipment, so operation can be adjusted for fluctuations in pipeline gas demand.

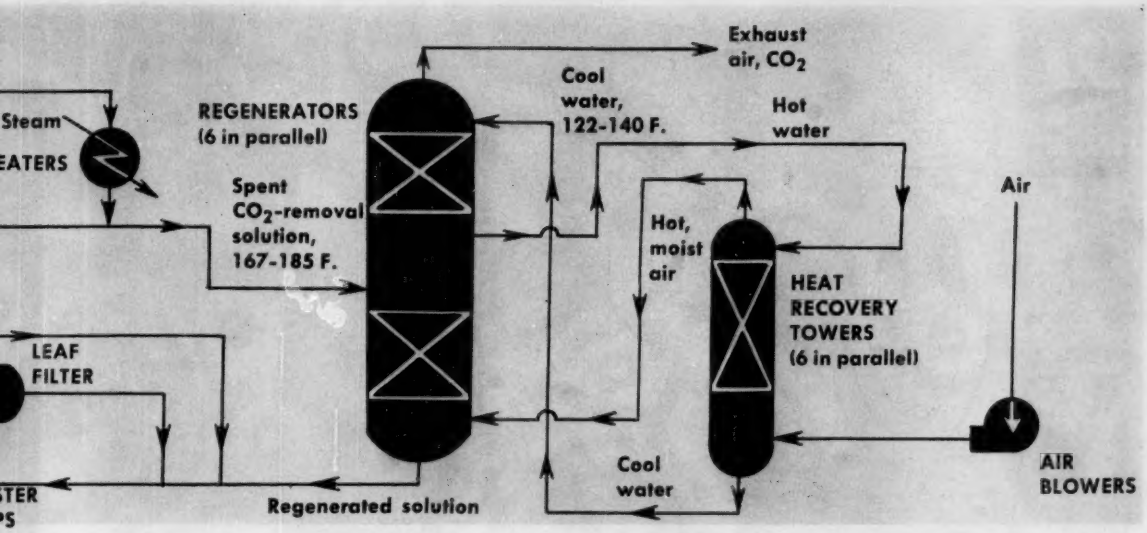
Over-all processing includes conventional removal of liquid hydrocarbons, removal of H_2S and CO_2, regeneration of the treating solutions (which contain the same salts but in different concentrations), and drying of the sweetened gas in a conventional glycol unit.

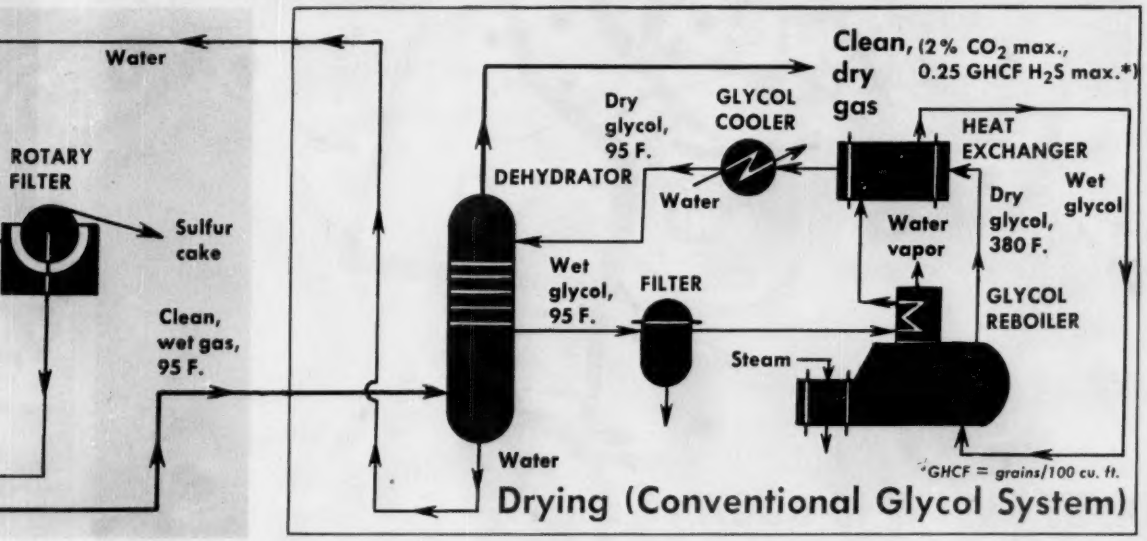
▶ **Following the Gas**—Feed gas enters at 1,050 psig. A dry-type separator removes liquid hydrocarbons; then the gas is heated and enters an absorption tower for H_2S removal, where its rises through a packed bed against falling treating solution.

Next comes CO_2 removal, in packed-bed contactors where the gas again rises against treating solution. Leaving the contactors at 122-176 F., the sweetened gas gives up heat to entering feed, then is cooled further and goes to a dehydration tower.

Bottom of the tower is a separator, and some water drops out there. More is removed by triethylene glycol on sieve trays in the upper section. Emerging gas contains under 2% CO_2, under 0.25 grains H_2S/100 cu. ft., and less than 6 lb. water/million cu. ft. It passes through continuous analyzers and on to the pipeline at about 1,000 psig.

One of the analyzers measures CO_2 content, and controls a line bypassing the CO_2-removal contactors. Since the contactors can lower the dioxide content to well under 2%, Transwestern uses the bypass to keep CO_2 level as close to this figure as





desired for sweetened gas that enters the pipeline.

► **The Solutions**—Spent solution from the H_2S absorbers goes to flotation towers, part of it passing first through digesters for acidification by CO_2 (*see reactions, in box*).

In the flotation towers, air completes sulfur removal from the solution, carries the sulfur to the top of the tower, and reactivates the solution. Sulfur is removed as foam from the tower top. The foam is settled and filtered, and the filtrate combines with solution leaving the bottom of the tower and returns to the H_2S absorbers. Sulfur caking out on the filter goes to a water-wash tank (not shown above), then is refiltered.

Spent CO_2-removal solution leaves the contactors, passes through large power-recovery turbines and is heated. Part of it goes to a flash tank to furnish CO_2 for acidifying the H_2S-removal solution; the rest is piped to regenerator towers.

In the regenerators, the solution falls against rising hot, moist air that strips the CO_2. The air gives its heat to water in the upper sections of the regenerators, then vents to the atmosphere. The water, in turn, heats incoming air in heat recovery towers.

Regenerated solution leaves the bottoms of the regenerators, returns to the contactors. About 10% of the returning stream is drawn off and sent through a recirculation loop containing a precoat-type pressure leaf filter.

The CO_2-removal solution gradually becomes oxidized in the regenerator, lowering its effectiveness. Transwestern remedies this by tapping off some of the solution leaving the regenerator, sending it to an undisclosed system that converts the solution to its reduced state.

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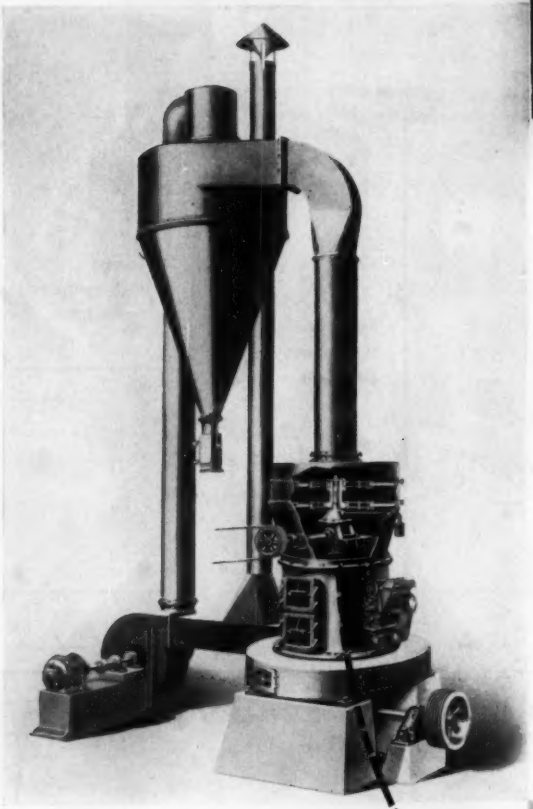

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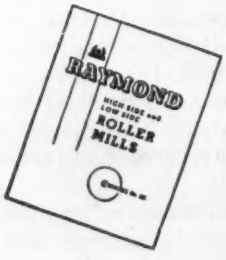

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```
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F = 60 ⑤
L = ₀2 ⑤
FOR E = 100(50)300 BEGIN ⑤
FOR C = ₀00002(₀0000001)₀000021 BEGIN ⑤
I = E/SQRT(R ↑ 2 + (6₀2832 * F * L — (1/(6₀2832 * F * C))) ↑ 2) ⑤
PRINT (FL) = E ⑤
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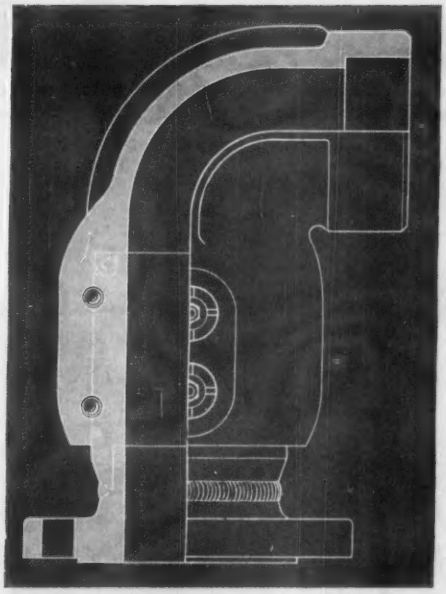
Use Swivel Joints for Flexibility



Properly selected, swivel joints provide flexible connections between moving elements of process units and relieve vibration, expansion, fatigue or settling stresses.

G. M. BAGNARD
Chief Engineer, Chiksan Co.

A swivel joint is a device that preserves the integrity of an all-metal piping system, yet portions of that system may oscillate, flex or revolve. This feature has long made the swivel joint a valuable component of chemical and petroleum processing plants.

Despite the familiarity of the swivel joint, many chemical engineers still have only a cursory knowledge of swivel joint construction and utilization. Primarily, this is because the joints look misleadingly simple. Thus, a swivel joint can be viewed as simply a pipe elbow or straight-through coupling with provisions for rotation added. To apply the unit, it would seem, all an engineer needs to know is the temperature and pressure limitations, pressure loss and the available materials of construction.

But to regard the swivel joint as just a piece of plumbing hardware is to miss many of the opportunities in process flexibility offered by the swivel joint, and to run the risk of misapplication. Actually, the swivel joint should be considered as an element of process machinery, along with pumps, agitators and other revolving equipment. The precision of manufacture of a quality swivel joint with its carefully machined surfaces and ingenious packing should take the unit out of the plumbing category.

Properly selected and properly applied, swivel joints can do jobs that are impossible with any other device, and can provide years of trouble-free service with minimum maintenance and attention.

Swivels Provide Twist and Turn Connections

The dozens of different process applications for swivel joints fall into three basic categories to provide:

- Leakproof connections between stationary piping and revolving equipment.
- An alternate, improved design in situations where flexible hose may be the first solution.
- A method of relieving stress in pipe systems subject to vibration, heat expansion or uneven settling.

The first of these categories clearly underlines the characterization of the swivel joint as an element of process machinery. When swivel joints are used to direct fluids or gases in or out of revolving equipment such as tumblers or mixing vessels, the swivels become moving elements within the machinery and are subject to all the vibration, fatigue and misalignment stresses to which the equipment is put. Maintenance and life depend on good design and quality manufacture.

One important application in this category is the use of swivel joints to support revolving steam coils within reaction vessels. The motion of the coils insures maximum heat transfer and has a self-scouring action which is of value in those instances where de-

Chemical services determines packing material

Teflon handles highly oxidizing fluids, esters, ketones and fluids not compatible with elastomers.

Viton A finds use with high temperature fluids, aromatics, liquid chlorine and other halogens, tetraethyl lead, chlorinated hydrocarbons, carbon disulfide, molten sulfur and strong acids such as concentrated sulfuric, red fuming nitric and hydrochloric acids. Material should give good service up to temperature range of 350 to 400 F. Do not use for esters or ketones.

Metallic material in the form of a stainless steel disk, treated to prevent galling, is suitable for extreme service at 600 F. to handle hot gases.

Hycar applications include petroleum derivatives, neutral or slightly acidic salt solutions, dilute acids (50% sulfuric, 20% hydrochloric, 20% nitric), alcohols, glycols, ethers, gases (oxygen not over 500 psi.) and vegetable oils.

Butyl handles liquid or anhydrous ammonia, gases (except oxygen over 500 psi.), ammonia derivatives such as hydrazine, acetone, methyl ethyl ketone and for certain hydraulic fluids such as Pydraul, Skydrol and Cellulube.

Neoprene can control alkaline and acid salt solutions and aldehydes such as formaldehyde.

Asbestos packing find use in saturated steam service.

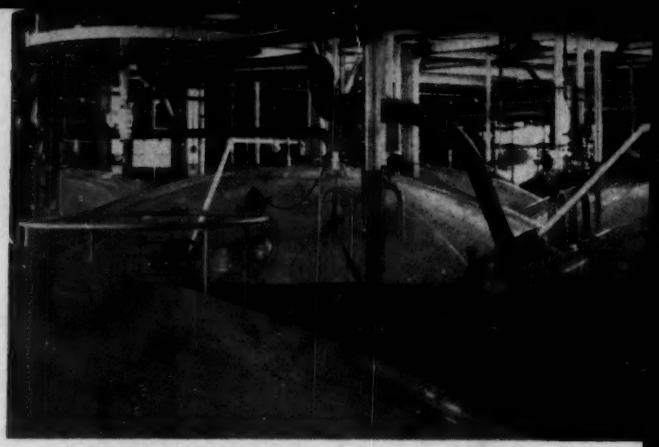


Fig. 1—Swivel joint in center supports moment load caused by the cantilevered downspout which fills three vessels.

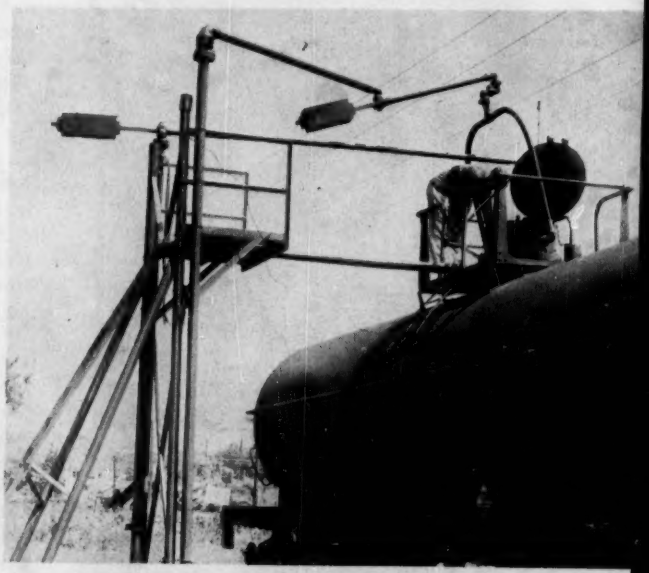


Fig. 2—Swivel joint functions as fulcrum and allows counterweights to balance cantileverd loading arms.

posits might form on the hot surfaces, thus decreasing the heat efficiency and requiring frequent cleaning.

Since swivel joints are capable of handling slurries or aerated solids, as well as liquids and gases, they are widely used at the outlets of ball mills and similar equipment. In this case, two or three swivel elbows may be used in series to provide a universal-joint connection that will automatically compensate for any misalignment between the revolving equipment and subsequent piping.

Swivels Give All-Metal Contact

When a flexible connection is required between two points, a properly designed system of swivel joints and straight lengths of pipe can provide the same flexibility as hose. Under many conditions the swivel joint connection provides a number of advantages that hose cannot offer.

When pressures are high, for example, a swivel joint connection retains its flexibility even when hose becomes ramrod stiff. At pressures as low as 200 psi., hose can become as rigid as steel pipe. Even at low pressures, the minimum safe radius of curvature for a 4-in. rubber hose is 40 in. against 8 in. for an equivalent swivel joint connection.

With hose, there is a constant danger of twisting and kinking, especially as the rubber ages and loses its resilience. Moreover, many chemicals will attack even the synthetic rubbers now available, eventually weak-

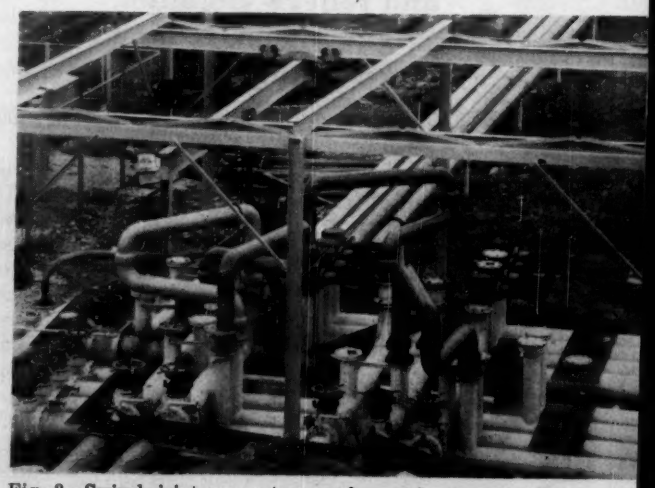


Fig. 3—Swivel joint connectors replace valve manifolds at tank farm to reduce chances of cross-contamination.

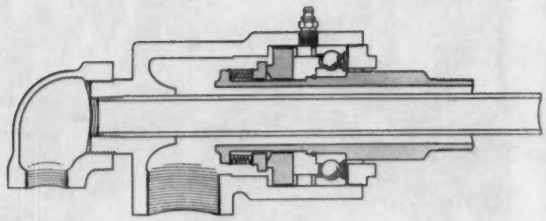


Fig. 4—Another variety of rotating joint has construction similar to mechanical seals used in centrifugal pumps. (Perfecting Service Co.)

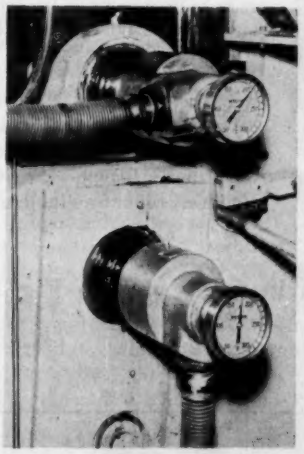


Fig. 5—Heat transfer oil enters rolls of coating machine through rotating joints. (Photo courtesy of Deublin Co.)

ening the hose and creating a safety or replacement problem. Downtime costs can easily exceed any saving that hose might represent. Special linings and reinforcing agents are at best only a partial solution.

An often overlooked advantage of swivel joints is that the swivel may also act as a balancing fulcrum as shown in Fig. 1. The heat-treated casting and heavy ball-races of the joint allow it to resist severe moment loads. With the addition of a counterweight as shown in Fig. 2, the pipe extension beyond the swivel joint may be cantilevered in space, allowing loading lines to be swung easily into place by hand.

In combination with quick-connect couplings, swivel joints have found wide application in manifold systems for tank farms, where a single swinging swivel-joint line takes the place of a complex of valves and headers. Such a system, as shown in Fig. 3, saves space, reduces maintenance and, most important, eliminates any cross-contamination through valve manifolds.

Swivel connections have complete predictability, which cannot be said for hose. When a flexible link is used to connect a stationary pipe with equipment that is oscillating or sliding back and forth in a known manner, such as in a filter press, a swivel joint system may be designed with predetermined arcs for each pipe element. By contrast, hose will shape itself in a more random manner, requiring wide margins of safety to prevent interference with other parts of the equipment.

Since there is a minimum radius of curvature that a hose can withstand without serious danger of kinking, swivel joints offer significant advantages where space or complicated piping arrangements present a problem.

Swivels Provide Stress Relief

An important application for swivel joints is in what would appear to be stationary service. For example, swivels may be used to relieve automatically the stresses imposed by differential settling of various parts of an extensive processing plant. In soft, swampy ground or fill, it is almost impossible to guarantee identical settling rates for various pieces of process equipment. Hence, a few hundred dollars' worth of swivel joints on the interconnecting pipes may save thousands of dollars in piling and foundation work.

An alternate solution to such a problem would be to install slip-joints at suitable points along the interconnecting pipes. But this would require shutting down the plant periodically and laboriously loosening and retightening the joints in order to relieve the accumulated stress. Swivel joints relieve stress continuously and without attention. Since the amount of motion is negligible, maintenance or service is seldom required, and the only cost is the price of the joint.

Swivels are also widely used to absorb vibratory motion, such as imposed by pumps, mixers or classifying equipment. Such vibrations can be transmitted through the entire piping system, increasing the danger of fatigue failure, wearing the bushings on

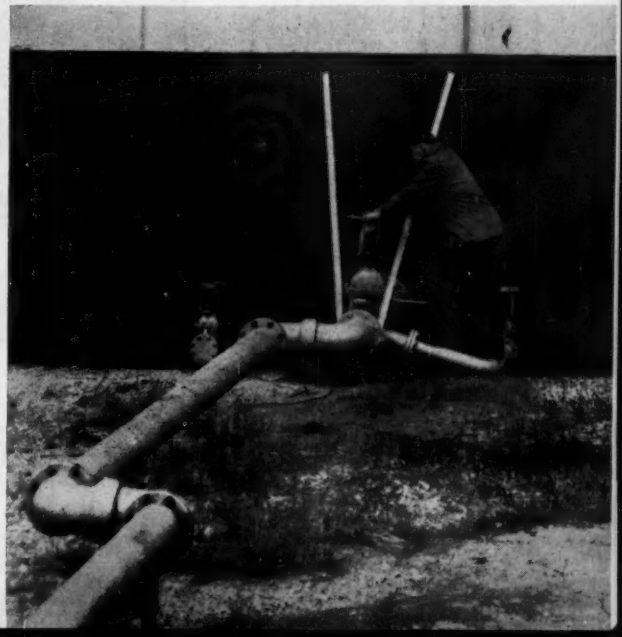


Fig. 6—As the tank in the background settles, swivel joints in the connecting pipeline provide stress relief.

auxiliary equipment and causing undesirable noise at locations far from the original source. Swivel joints on the pipes leading to or from the troublesome equipment will effectively dampen out this vibration.

A similar application is in relieving the stress imposed by thermal expansion and contraction. Expansion loops are the standard method of dealing with this problem, but in many cases there is not room within the equipment or plant for such loops, or else it is imperative that the length of pipe be kept at an absolute minimum. Moreover, the cost of such loops is generally higher than that of swivel joints. Since swivel joints are available that can withstand temperatures as high as 600 F., situations will rarely be encountered where suitable swivel joints for thermal relief cannot be specified.

A somewhat different, but very common use of swivel joints is in relieving torsional stress in a flexible hose. One of the major causes of kinking in hose is the axial twisting that may take place as the free end of the hose is moved about. This stress can be eliminated by using a single swivel joint at the point where the hose connects with the stationary pipe.

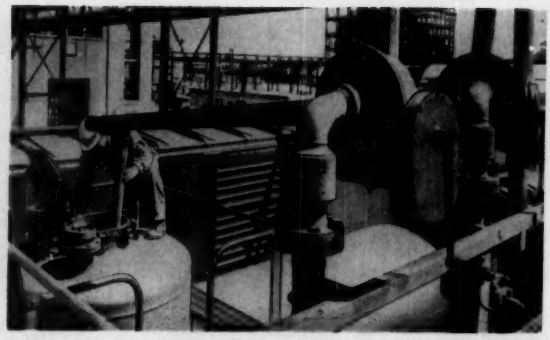
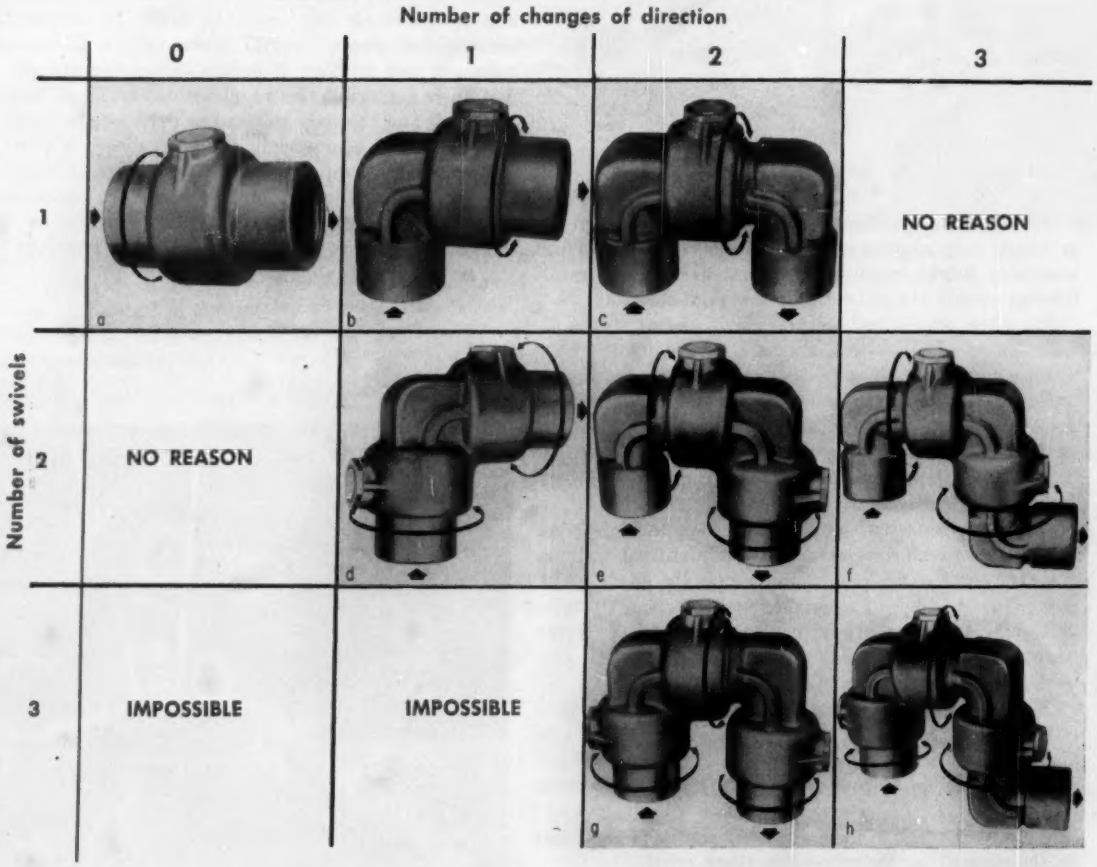


Fig. 7—Gear-driven swivel joint for loading chemical products does not hinder platform clearance. (Photo courtesy of Continental-Emsco Co.)

Also, in many cases a hose is required to operate in a place perpendicular to the stationary pipe to which it is attached. Hose, alone, would require a large radius of curvature, but a single elbow swivel at the pipe con-

Swivels give rotation in many planes—Fig. 8



nection can make the turn in a very tight radius.

Swivels Can Give Many Planes of Motion

In the specific design of a swivel-joint system, there are two fundamental requirements that must be met. The system must fulfill its basic objective, providing the flexibility or rotational capability asked. At the same time, the mechanical requirements of the swivel joints themselves must be recognized. These requirements are not unlike those of any ball-bearing device, but the determination of the loads on the races is complicated by the three-dimensional interaction of the pipes and swivels that make up the system.

The flexibility of a completed swivel joint system is misleading. Individual swivels are quite restricted in their range of action, and unless this is recognized, severe distortions and premature failures will occur.

There is no universal-joint action in a single swivel. On the contrary, in the case of a straight-through swivel, the input and output must be in exact linear alignment if whiplashing of the pipes and undue wear on the packing and races is to be avoided. In this case, the output of the swivel is a straight line, around which the output pipe may rotate as shown by Fig. 8a.

If the input swivel is part of a right-angle elbow as shown in Fig. 8b, the output pipe may lie anywhere in a plane perpendicular to the line of the input pipe, with one end originating at the swivel and the entire plane offset from the swivel by the radius of curvature of the elbow.

If a second, identical swivel is now added to the end of the second pipe (Fig. 8e), the output becomes a series of planes, each of which is perpendicular to the first output plane and, therefore, parallel to the original input pipe. Each output plane is offset from the original input pipe by the length of the second pipe plus twice the radius of curvature of the elbow joints.

This combination of parallel and perpendicular planes can be changed only by the addition of a third swivel either in the form of a third length of pipe and elbow, or by substituting for either of the first two elbows, a swivel joint at both input and output.

In brief, each time a swivel is added to a system, another plane of rotation is added, either parallel or perpendicular to the plane of the previous swivel, depending on whether a straight-through or elbow unit lies between. With seven swivels, five elbows and interconnecting pipes, complete flexibility in all planes may be achieved.

How to Design the System

With these basic ground rules in mind, it is possible to design a complete swivel-joint system with maximum economy of equipment.

One end of the flexible connection is taken as fixed, with the inlet pipe defining a definite line in space. The plane of the inlet section is any one of the family of planes containing this line.

The moving end of the flexible connection is also defined as a line in space, but it in turn defines a plane (curved or flat) traced by the line as the connected equipment moves from one extreme position to the other. The task of the designer is to select the combination of right angle and parallel planes that will translate the motion most directly from the input to the output connections.

Once the number and type of swivels have been established, the designer may compose the flexible link out of straight lengths of pipe and one or more styles of combination swivel joints such as those represented in Fig. 8.

The most common swivel joint system is a simple dogleg consisting of two straight lengths of pipe connected by two elbows and a single swivel (Fig. 8c) plus suitable swivels at the two connecting points. The two

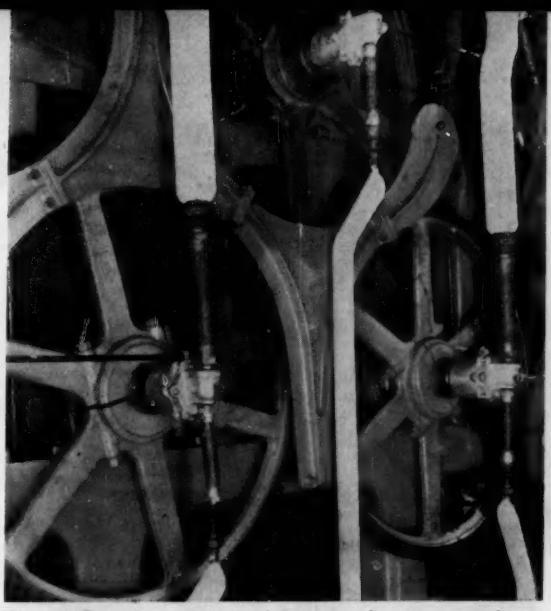


Fig. 9—Rotating pressure joints supply steam to large paper-machine dryers. (Photo courtesy of Johnson Corp.)

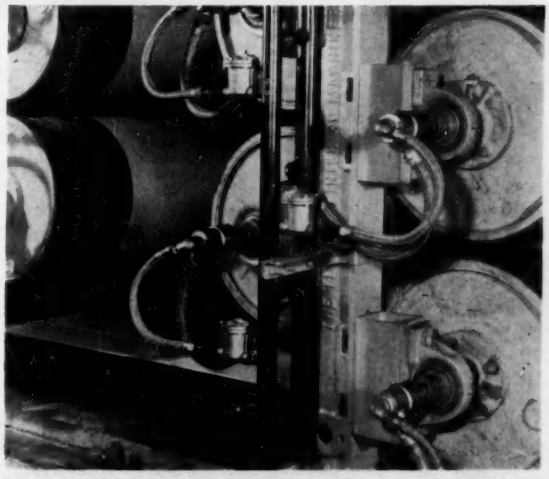
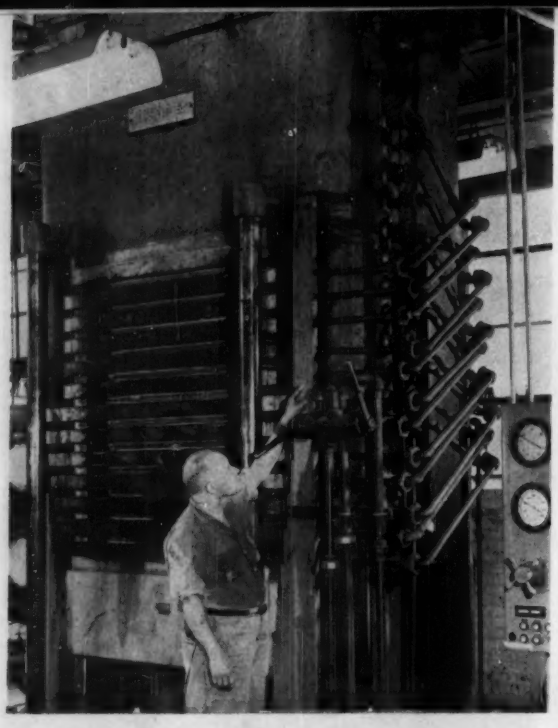


Fig. 10—Multiple use of rotating unions supply steam to drying rolls. (Photo courtesy Perfecting Service Co.)



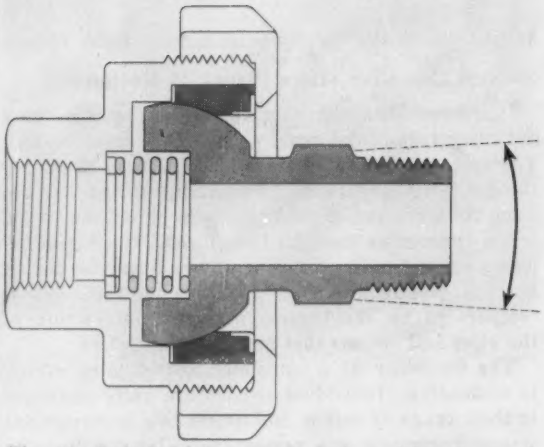


Fig. 11—Swivel joints connect dogleg piping to supply steam to multiple-platen laminating press. Ball-type revolving joint permits up to 10° angular motion plus 360° swivel action. (Photo courtesy of Barco. Mfg. Co.)

pipes of the dogleg are required to move in parallel planes since they are joined by only a single swivel. The moving end of the system must, consequently, remain in a plane that is exactly parallel to the line established by the input pipe to the dogleg. Otherwise, distortions are certain to occur. An additional swivel such as shown by Fig. 8f in the center of the dogleg will compensate automatically for the slight misalignment that is almost certain to exist in any such application.

Double-Race Construction

The cutaway drawing on p. 175 of a typical swivel joint illustrates the source of the unit's structural strength. Two ball-bearing races provide solid resistance against thrust or tension loads. Even more important, the double-race construction gives the rotating element a great deal of moment-load strength. Hence, the swivel can support heavy overhung loads without failure.

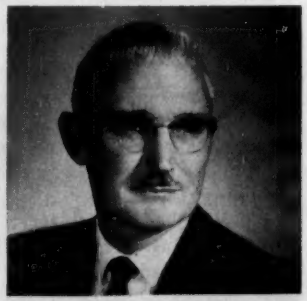
The same drawing illustrates the method used to insure leak-proof performance over long periods of operation. System pressure acts against an elastic packing material to maintain a perfect seal. A metal wearing strip bonded to the packing provides metal to metal contact between the stationary and rotating elements of the joint and, hence, lengthens the life of the packing. In one type of swivel joint, the packing may be replaced without disassembling the unit or removing it from the line.

Swivel joints are available in a wide variety of metals and packing materials. The table on p. 176 lists the packing recommended for service with various industrial chemicals and petroleum products.

This article deals, primarily, with swivel joints of the ball-bearing variety such as manufactured by the author's company. A number of other swivel and rotating joints are available, however, as illustrated by Figs. 5, 7, 9, 10 and 11. Each has its own special fields of application or usefulness. In many instances, the torque and moment load do not justify the expense or complexity of ball-bearing swivels that require special packing arrangements.

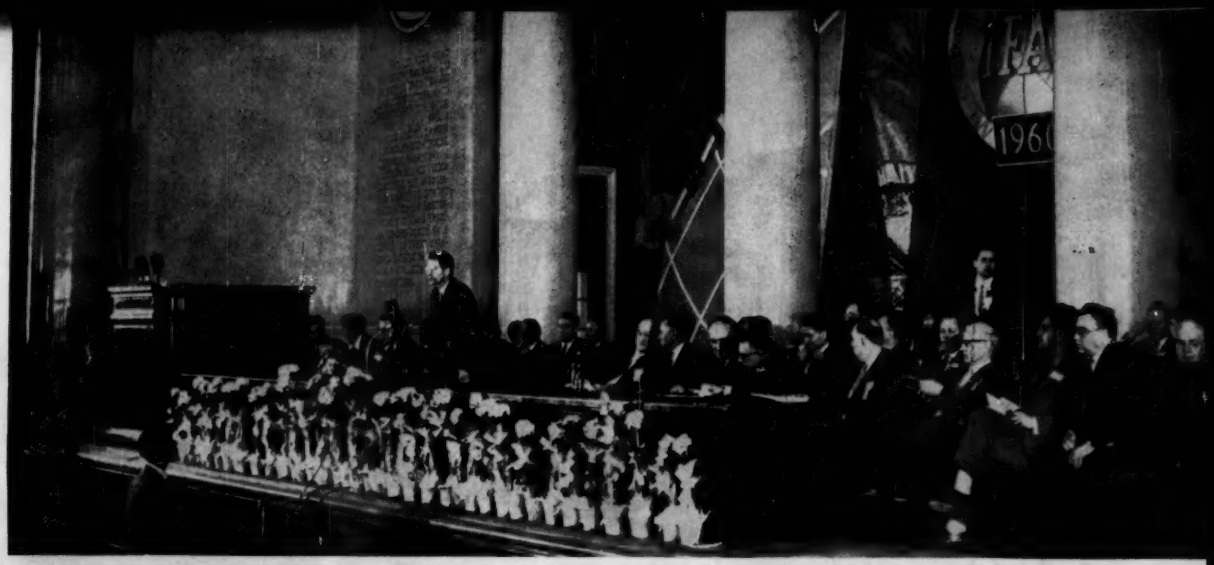
The result is a great variety of rotating devices from which the designer can choose. All of the rotating devices follow the basic rules outlined in this article.

Meet the Author



G. M. BAGNARD *has been chief engineer of the Chiksan Co., Brea, Calif., a division of Food Machinery & Chemical Corp., for eight years. Brought to Chiksan from Douglas Aircraft in 1944 to establish the company's test facility, he functioned as chief test engineer for eight years prior to promotion to his present position.*

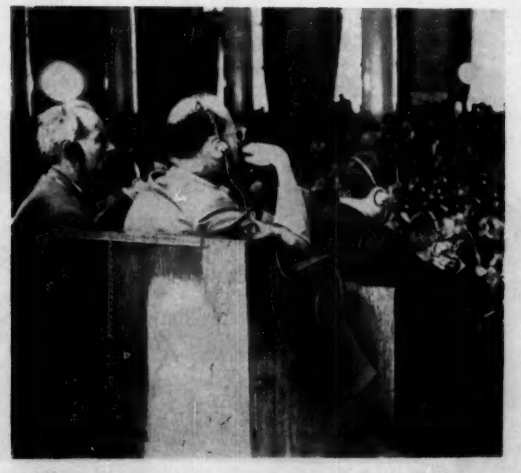
He is the holder of several patents and author of numerous technical articles. His activities include American Ordnance Assn., American Management Assn., API, ASTM and ASTE.



Moscow Control Conference

From on-the-spot coverage of the First Congress of International Federation of Automatic Control, here are first-hand impressions of worldwide process control.

ERNEST CONINE
McGraw-Hill World News
Moscow, U.S.S.R.



An American expert in chemical process control stood in a hallway of Moscow University and showed a Soviet specialist a color photograph of Tidewater's highly automated Delaware Refinery.

"Are there similar refineries in the Soviet Union?" he asked.

"There are some similarities," answered the Russian with no further comment.

This brief episode just about sums up the amount of give-and-take among eastern and western delegates in the chemical and oil-refining industries during the First International Congress for Automatic Control, concluded in Moscow in early July.

Although the initial meeting as a whole was judged a success, there was general agreement among delegates from the non-communist world that the program for automation of oil and chemical processing industries was weakest of all. There were only eight papers on these subjects in the section devoted to industrial applications of automatic control, and, in the words of one American, "half of those were theoretical."

Among 19 institutes and plants opened to delegates on special tours (29 were originally offered), not one was a chemical processing plant or research institute.* Neither in formal papers nor lobby conversations did Soviet delegates have much to say on the subject.

Nevertheless, the Congress gave western specialists their best chance ever to talk with Soviet colleagues on their home ground and to judge Russian progress in automatic control. Their impression: America is well ahead in industrial applications as of now. But Soviet emphasis on theoretical advanced systems—though often considered "pie-in-the-sky" weakness by outsiders—might someday enable them to leapfrog the western world.

* For impressions of the one delegate who privately saw a process industries plant, see interview on pp. 184-5.

Looking south from Red Square outside the Kremlin's wall, delegates saw famous 16th-century Saint Basil Church, now a museum.

Members of Scientific Instrument Manufacturers Assn. handed out tons of Russian-language product literature to all who asked.

At SIMA exhibit in Polytechnic Museum, each of 41 British firms spent average of £3,000 on displays, sold 95% of their instrumentsfor £220,000.

At theoretical Institute of Automatics and Telemechanics, westerners saw 12-variable optimizing controller and other prototypes.

In the general sessions, engineers heard Russians praise control theory, Red Chinese praise Communism. Next Congress: in Switzerland in 1963.

Overturning language barriers in hallways, delegates sought bilinguists to make points.

(But, opined one American, "if Russians try to go straight from manual or partially automatic control directly to full closed-loop computer control, they will probably fail and have to backtrack through the same kind of development which we went through. By trying to pull themselves up by their bootstraps, they will wind up hanging by their toes.")

Some 800 foreign delegates, including almost 150 Americans, attended the meeting which was sponsored by the International Federation of Automatic Control. Of 285 papers presented, the Soviet Union contributed 81, the U. S. more than 70 in sessions covering theory, components and applications. About half the papers were theoretical.

Delineating the Soviet Line

The Soviets lost little time in explaining their own emphasis on theory. V. A. Trapeznikov, a leading member of the U.S.S.R. Academy of Sciences and head of the Institute of Automatics and Telemechanics, made these main points in an opening-day speech widely judged the best single presentation of the Congress:

- Automatic control theoretical work plays the role of "strategic reconnaissance" for the whole field—to find out what the machines can or cannot do and how their potentialities can be extended. "While in the recent past theory was primarily incidental to automatic control engineering, it will be in the future assigned a bigger role."
- Most important problems to be studied now are optimal control techniques and synthesis of control structures approaching optimal, principles underlying synthesis of adaptive and self-learning systems, and design of automatic machines which supplement or supplant the human engineer.
- Automation will be used increasingly to store information, "relieve the human brain of routine work" to give man more opportunity for creative endeavor. In addition, machines may acquire "creative" skills that will enable them to improve automatically their own performance.
- With basic research growing by leaps and bounds, scientists can best avoid blind alleys by contacts with their opposites in other countries to exchange information.
- Progress in automatic control theory and practice is tied to advances in hardware. Here the most important problem is reliability of components and the systems in which they are used.

A Crowded Technical Bill-of-Fare

Since up to ten or eleven technical sessions took place at one time in the tightly packed schedule, and the printed papers filled four thick volumes, delegates had opportunity to do little more than sample the proceedings, hardly could digest the whole fare.

In sessions on chemical processing, some delegates thought the most valuable paper was on transient behavior of multicomponent distillation columns by H. H. Rosenbrock and three other Britons. They told of experimental work in an eight-plate column distilling a mixture of toluene, isooctane,*p*-xylene. Object was to check digital computer solutions of equations of mass transfer. They found the same degree of correspondence between theory and experiment for the ternary as has been found for binary systems.

J. C. Orcutt and D. E. Lamb of the U. S. gave a paper on stability of fixed-bed reactors. They noted that unsteady-state behavior of fixed-bed catalytic reactors with feed-effluent heat exchange has been studied to determine conditions under which disturbance in feed composition or temperature results in continuous change in effluent composition and temperature.

To test the validity of mathematical development, a complete nonlinear system, consisting of a packed catalytic ammonia reactor with an external heat exchanger, was simulated on a large analog computer. Conditions resulting in stable and unstable operation were observed by perturbing closed-loop system by step changes in inlet temperature. Regions of stable operation were found to agree with those predicted by system stability criterion.

A group of Polish specialists presented a paper on a Polish-made computer (SKRZAT-1) for automatic control of such processes as chemical synthesis, distillation and blast-furnace operation. Machine, with ferrite-diode circuitry, performs 8,000 additions or over 1,500 multiplications per second.

Russia's contribution was a paper by V. M. Ordyntsev on computer control of an ammonia plant, but following the discussion delegates were left with the feeling that it probably didn't describe an actual operating installation. France also discussed computer control, citing economics of ammonia plant operation, in a paper by J. G. Auricoste. This, too, represented only a paper study.

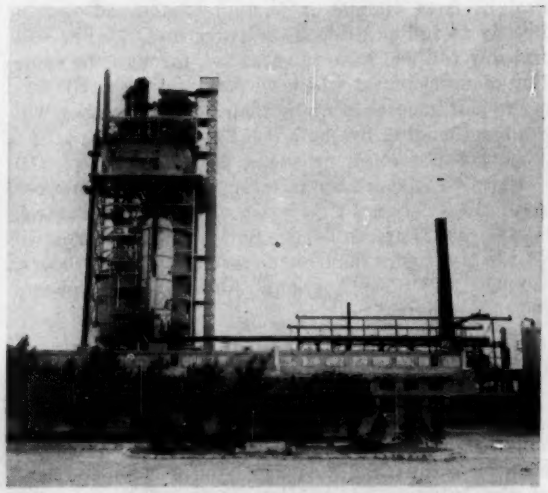
Conversations in Moscow Hallways

In the technical sessions, according to most opinion, Russians accounted for three-quarters of the discussion and, as one American commented, "they obviously had gone over the papers carefully beforehand." In corridor conversations at the University and at the skyscraper Ukraine Hotel, where delegates stayed, Soviet theorists were talkative. But there was little or nothing said about practical applications in the U.S.S.R. The Soviets themselves displayed a little curiosity—about the technology of natural gasoline plants, for example.

Since the Congress was planned when Soviet-American relations were growing better but held when they were definitely on the downgrade, U. S. delegates arrived in Moscow a bit dubious about the treatment they would get. At the personal level, they need not

(Conine's report continues on p. 186)

After he returned to these shores, David M. Boyd, Jr., of Universal Oil Products, told CE about his exclusive visit to a processing plant.



ONE MAN SAW SOVIET CONTROL AT WORK

DES PLAINES, Ill.—One member of the American delegation of engineers and scientists in Moscow was David M. Boyd, Jr., chief instrument engineer of Universal Oil Products Co.

Boyd, who last fall played host to Russian control experts visiting the Chicago ISA meeting, asked and received permission to visit a refinery. Here are his answers to questions posed by *CE* reporter Bruce Cross about the IFAC meeting and his trip to the Baku Refinery.

What was the purpose of the Moscow Congress?

Four years ago, a group of control and process engineers meeting in Heidelberg decided to form the International Federation of Automatic Control and to hold its first meeting in Moscow.

In the United States, five technical societies expressed interest—AIChE, ASME, AIEE, IRE and ISA—and the American Automatic Control Council was formed for their joint participation. As vice president of the Council, I was vice chairman of the U. S. delegation. This IFAC Congress was an international meeting on automatic control only.

Did anything emerge from the Congress that was unknown to the West?

I don't feel that there were any real breakthroughs in process control announced in Moscow, but no one expected breakthroughs. The meeting was held on a high technical and professional level.

Which papers contributed most in the chemical and petroleum areas?

To me, the most interesting were presented by Dr. David Lamb, University of Delaware, and by Dr. H. H. Rosenbrock, Constructors John Brown. In the automatic control literature, emphasis has been on design of control hardware, but both these papers deal with process understanding, with dynamics of processes we try to control.

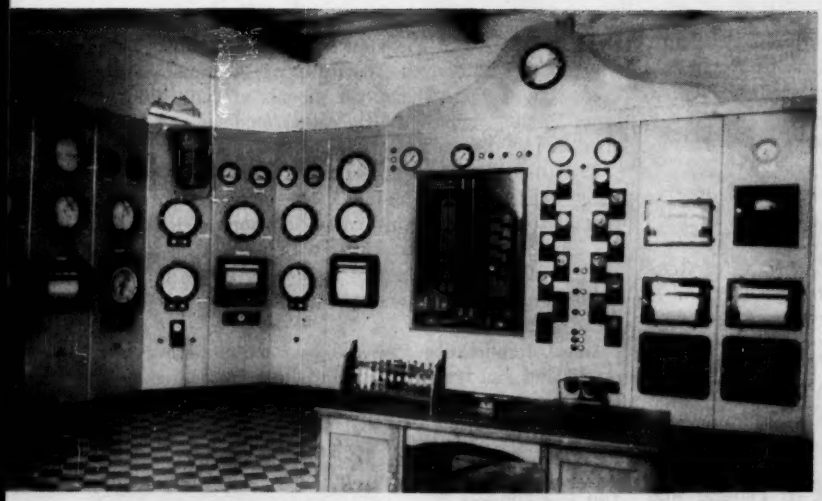
In light of the summit collapse in Paris only weeks before the IFAC Congress, what treatment did western delegates receive?

Characteristic was the rare banquet in the Kremlin's Great Palace at the end of the Congress. After a lavish feast in Saint George Hall, there was entertainment—Bolshoi Theater ballerinas, folk dancers, acrobats—and a speech by Deputy Premier Nikolai Ignatov.

Another personal example was an incident that happened at a hotel restaurant in Baku. A young lady from Intourist, holding up several hundred dollars worth of travelers checks, asked if I were missing anything. Although the checks were found on the commercial plane from Moscow, I hadn't even known they were lost. No one would accept an award for their fast return.

To what do you attribute your success in being the only western delegate who was allowed to visit a process plant?

To start the ball rolling, I had a letter from AIChE asking me to make such a visit, and this certainly helped. I asked permission through friends on the Central Scientific Committee to visit a refinery, not specifying any particular



Three-year-old gasoline-producing area of the Baku Refinery has three catalytic crackers. One fluid cat cracker (*left*), visited by Boyd, was controlled from central room (*above*). Note control panel layout and mounted instrument cases.

plant. Permission was slow in coming [four months], but it did come after I was in Moscow.

What did you see of the Baku Refinery?

The chief engineer of Baku District, Baku Refinery plant manager and eight to ten other plant officials guided me through what I saw of the refinery, the gasoline-producing part.

Three-years old, this section is part of what I would guess to be a 100,000 bpd. refinery. I saw three cat crackers, a sulfuric acid alkylation unit, an aluminum chloride isomerization unit and the silica-alumina bead catalyst manufacturing plant. Of the crackers, one is fluid bed and the other two are gas-lift moving bed.

What about process control? Was instrumentation similar to U. S. practice?

All the automatic controls were pneumatic. There seemed to be as many automatic controls and instruments as a comparable refinery here, but there also seemed to be three times as many operators as we would have.

Though pneumatic control was the rule, there were some electronic recorders: the unit I examined was a temperature recorder with vacuum tube circuitry. I don't know whether electronic control has made inroads to other process plants, but I'm fairly sure that Russia's chemical process control practice follows lines similar to petroleum.

Did you see any evidence of application of computer control of processes?

I saw no application of computers at Baku. I did learn, though, that much work is being done at the Institute of Automatics and Telemechanics on studying optimization computers.

Are there instrument engineers and mechanics in the plant?

Yes, there were instrument engineers and mechanics at Baku doing jobs similar to those in our refineries. I had no way, however, of determining how much training they had.

How about the design sections?

There are instrument engineers in design sections, but I didn't find any chemical engineers who were interested in instrumentation.

Of the large American group, only a few were directly interested in problems of process control. Of these, several gave *CE* brief impressions of the Congress. None, other than Boyd, was able to visit a chemical plant in Russia.

Said Robert Otto, Monsanto Chemical: "Facilities were crowded for all the technical excursions, but there were no scheduled trips to process plants." Of hardware he saw, Otto had this to say: "The most characteristic thing was that the Russians didn't show much. What we saw had been shown to all visitors for the past two years." To Otto, the most important paper given by the Russians was on control of an ammonia plant, but when pressed by western delegates for more detail, the speaker seemed to hide behind the language barrier.

Joel Hougen, also of Monsanto's Research & Engineering Div., had this to say: "Though the Russians were very good in theory and stressed this, it would be difficult to evaluate their progress in application. And they seemed to have only superficial interest in western application."

Process-control expert James Mozley, Johns Hopkins Hospital, visited both theoretical and applied institutes of automation. Said he, of Russian application: "I got the impression that they are trying to emphasize chemical applications, but that theory—of which they are rightfully proud—is strong.

"Typical of the attempt to stress application is Kiev's three-year-old, 2,000-man Institute of Automation that we visited. There the work is two-fold: production of instruments and measuring devices and development of control systems by particular industry specialists."

DuPont, which sent a process control expert to the Congress, refused comment on the meeting.

have worried: they got VIP treatment, reserved in most countries for movie stars and politicians.

Delegates enjoyed caviar and vodka as well as more prosaic dishes at a reception by the National Academy of Sciences. Hosts made available tickets to the famed Bolshoi Theater, and trips were arranged for the ladies to nurseries and housing projects. To cap it all, in the memory of most, visitors were honored by a reception in the Kremlin's Great Palace.

International politics reared its head only briefly. Speakers at the general sessions—including Trapeznikov, IFAC president A. M. Letov (Trapeznikov's deputy), IFAC ex-president Harold Chestnut (of General Electric) and a spokesman for Switzerland—limited their remarks to friendly greetings and predictions of great things to come for automation.

Trapeznikov alluded only once to the Marxist conviction that automation's full fruits can be realized only in a "rationally organized," i.e., communist society. A Chinese spokesman did arouse anger among western delegates with a frankly partisan speech extolling the virtues of communism in general and Red China in particular.

Probably more serious was an informal attempt by the communist countries to win approval for a basic change in the organization of IFAC. Their suggestion: a strong secretariat and a government-to-government relationship similar to that of the International Atomic Energy Agency. Because of Red Chinese and East German membership in IFAC, the move was strongly opposed by U. S. and other western delegates, and the Soviets backed down.

Although growing tension between the Soviet Union and the U. S. didn't manifest itself in any discourtesies, some delegates did get the impression the Soviets were more sensitive about what westerners could see and learn than they might otherwise have been.

Most of the 19 establishments on the final tour lists were old chestnuts which have been viewed by many foreign visitors before.* These included the Red Proletarian Machine Tool Plant in Moscow, with its automatic gear-wheel production line, and the First State Bearing Factory. Disappointed delegates pressed for additional visits—specifically to either the new refinery at Grozny or a plastics plant in Leningrad—but to no avail.

Opinion was divided over reasons for this reticence. Some delegates pointed out that even in western countries permission to see new industrial applications is hard to come by for competitive reasons. Some were convinced the Soviets have no automation of chemical processing of which they are proud.

But probably the most popular view was the one expressed by an American process control man: "I think they are embarrassed to show us their old plants, and they have no intention of showing us any that have good stuff in them."

Visiting the Russian Technical Institutes

Some of the institutes on the tour list, however, were impressive in the view of some delegates. Those who toured Moscow's Institute of Automatics and Telemechanics saw optimizer models of four different types, including two multichannel models, and equipment for synthesizing self-adaptive systems.

The Institute's pneumatic logic equipment apparently had progressed, since last shown to outsiders, from lab prototypes toward production models. Most of the pneumatic logic units, which could be used as simple, cheap components in computers hitched to simple production processes, use interacting airjets instead of moving parts.

Great importance attached to remote measurement on oil and gas transmission lines was indicated by an unconventional long-line telemetry system using frequency modulation and exponential transducers. System, which operates over distances greater than 300 miles, uses 50 channels in the frequency range between 100 and 500 cps.

On the basis of what they saw in Moscow, Leningrad and Kiev, delegates, nevertheless, wondered just what real automation the Soviets have in actual use. They saw very little. Spokesmen for the Sverdlov Machine Tool Plant in Leningrad, for example, said continuous control systems are planned for next year's production, but they are nowhere to be seen now.

Conclusion is that despite the big push for automation at the Communist party's 21st Congress over two years ago and repeated at last year's Central Committee plenum, the Soviets are still searching for "ideal" answers and have not yet given the go-ahead for widespread application.

An opinion on this point was offered by Prof. Rufus Oldenburger of Purdue, past president of the American Automatic Contral Council. He noted that there were many institutes in the Soviet Union doing research, but there seems to be a big gap between theoretical or laboratory work and actual engineering.

"In the U. S., I am a theoretical mathematician, but I also turn my ideas into hardware. In our country, applications grow from the demands of industry. I think that here's the weakness of the Soviet situation. I've talked to many Russians who are not in touch with the applications end. As I see it, Russians are strong on theory because they start from the other end: they love mathematics."

As to who is "ahead," Oldenburger commented: "We have no way of knowing what they have. I do know the U. S. is in exceptionally strong position in industrial work. We have a tremendous automatic control industry, and from what I know there's none greater in the world." He conceded, however, that optimal and self-adaptive equipment in Soviet laboratories appears to be "ahead of anything we do in the States."

Most observers, nevertheless, are convinced that automation is high on the government's priority list, as evidenced by high-level support given IFAC.

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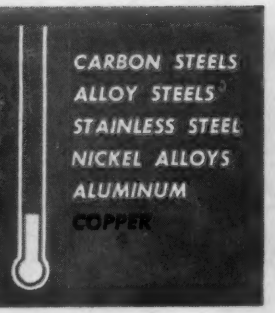
* For earlier impressions of U.S. visitors to the U.S.S.R., see *Control Engineering*, a McGraw-Hill publication, Aug. '56, pp. 57-9, and Nov. '58, p 59*ff*.

This is the sixth of our series of articles on low-temperature construction materials, for service from subzero to absolute zero. Copper is the final material we will discuss. One more article, to appear in a later issue, will be a critique from a major designer of low-temperature process plants.—Editor



COPPER

AND ITS ALLOYS FOR LOW TEMPERATURE VERSATILITY

C. LAWRENCE BULOW
Bridgeport Brass Co.

The low-temperature properties of copper and its alloys early lead to their use in laboratory and commercial cryogenic equipment. Chief among these properties is copper's remarkable retention of its ductility at low temperatures. Copper and its alloys have long been noted also for their ease of fabrication and formability. Development of higher strength alloys and newer welding and brazing techniques have increased even more copper's usefulness for low temperature applications.

With few exceptions, the tensile strength and hardness of wrought copper and its alloys increase quite markedly below room temperature down to below the temperature of liquid hydrogen (−423 F.). A further increase is discernible as the temperature is reduced to that of liquid helium (−452 F.). The tensile strength of annealed copper at these temperatures is about twice that at room temperature and the difference between hard drawn and annealed copper is only 25% of the difference at room temperature.[4] Copper alloys always show greater tensile strength at low temperature than copper itself but their percent increase as the temperature drops is less than copper's.

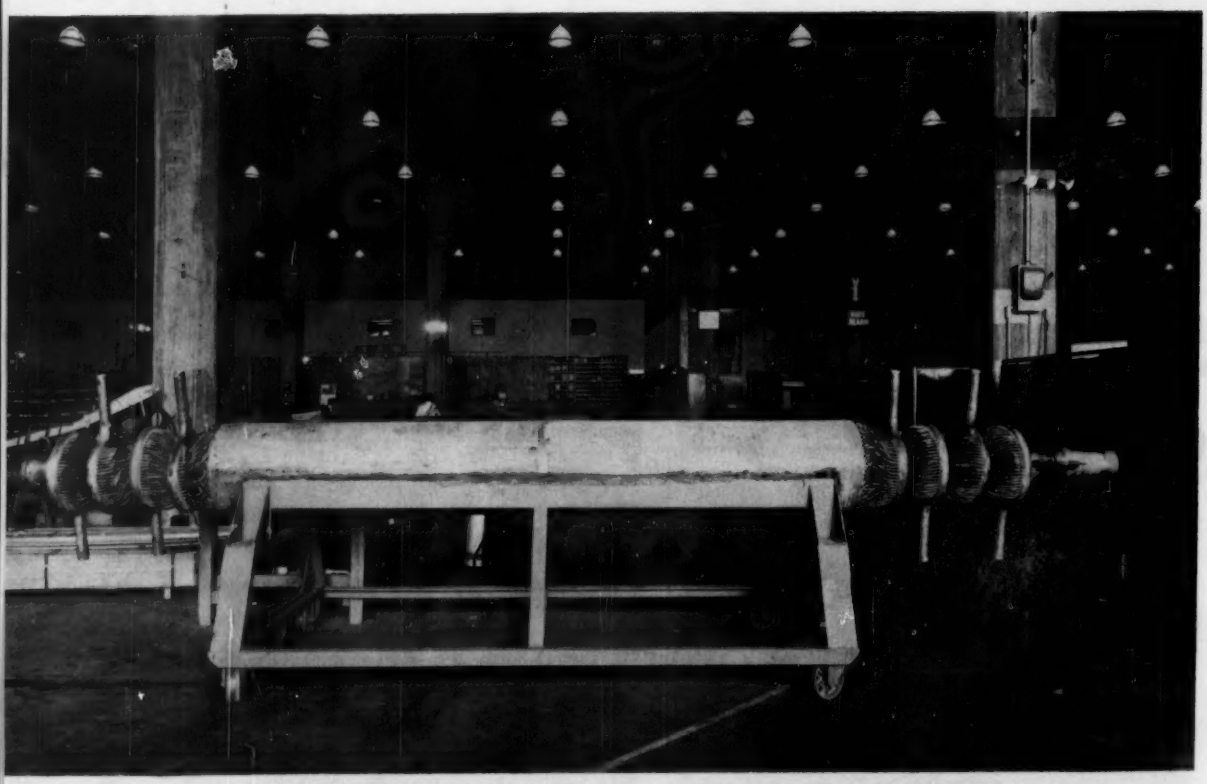
Yield strength and ductility do not change very much when the temperature is lowered. This is because copper and its alloys harden more for a given amount of strain or deformation at low temperatures than they do at room or higher temperatures. In other words, the ductility remains more or less constant as the temperature is lowered and, therefore, in order for fracture to occur, a certain elongation must be reached. This, in turn, means that in order to produce this extension or stretch at low temperature, a much higher stress must be applied.

Drop weight and impact tests (either Charpy or Izod tests) are generally preferred as a measure of the ductility since they give an indication of how the metal or alloy behaves when dynamically loaded or subjected to multidirectional stressing. However, insofar as the wrought copper alloys are concerned, the more common ductility tests (elongation and reduction of area) correlate quite well with the impact strength. Note that within the group of alloys given in Table I, which range from 55 to 99.99% copper, most of the alloys do not show much variation in their notched bar impact values—that is, they remain essentially unimpaired down to the boiling point of hydrogen.

Wrought copper and quite a few of its alloys show a gain in impact strength of 7-15 ft. lb. between room and the lowest test temperature. Alloying copper with silicon (3%), zinc (30%) or nickel (20-45%) gives alloys with substantially increased impact strengths—25 or more ft. lb. higher than copper itself.

This retention of ductility—a characteristic of all single-phase copper alloys—is a very desirable property for low temperature service. The absence of brittleness in most copper alloys makes them most trustworthy, since a minor local imperfection or other "stress raiser" is unlikely to cause failure—rather, plastic deformation will relieve the stress. This would be particularly true of pressure vessels which normally are not subjected to sudden loads. Bolting, tie rods, etc. can be stretched considerably before fracturing.

It has been shown that the fracture relationships of copper-base alloys in the as-cast condition are different from those of steel—a Charpy V-notch value of



A coiled-tube type, low-temperature heat exchanger fabricated by Air Products, Inc.

10 ft. lb. does not indicate a brittle condition for the copper-base alloys. Copper-base alloys with Charpy V energy values from 3 to 10 ft.-lb. plastically deform even in the presence of a sharp notch. These alloys fracture in a truly brittle manner only when the microstructure is of a nonductile type, indicated by a tensile elongation value below 2%. An alloy with an all alpha microstructure will have unusually high notch ductility and Charpy V energy (impact strength). Since these alloys harden and strengthen with decreasing temperature, the modulus of elasticity, from stress-strain curves, tends to increase with decreasing temperature.[4]

For metals which show a large increase in tensile strength at low temperatures, there is a corresponding large change in fatigue strength. In addition, the effect of temperature on notched specimens is very much less than on unnotched specimens. The fatigue strength of copper improves continuously down to −452 F. and then remains constant. This suggests that the tensile properties will also have reached a constant value at −452 F., but this has not been confirmed. Small extrusions and intrusions occur on copper when subjected to fatigue tests from room temperature down to −452 F.

Fatigue tests on free machining brass (62% copper, 35% zinc and 3% lead) show at room temperature and at −40 F. endurance limits (5×10^7 cycles) of 26,000 psi. and 27,000 psi., respectively, for unnotched specimens and for notched specimens (45°, 0.010-in. radius at base), 17,000 psi. and 17,450 psi., respectively. It should be noted that this is a leaded brass and the presence of an appreciable quantity of lead increases the notch sensitivity at room temperature. Table II summarizes this discussion.[1]

Available data on the thermal expansion of copper and its alloys are rather spotty. The data, however, do cover the wrought copper-nickel series of alloys completely and both ends of the copper-zinc series of common wrought alloys are represented by copper, Muntz metal and free machining brass (leaded Muntz metal). Table III shows some typical values.

Thermal Properties Ideal at Low Temperature

Specific heat data are also limited at this time.[1, 6] At moderately low temperatures the drop in specific heat is not very large, but at very low temperatures the drop-off progresses quite rapidly. This is because the specific heat, due to thermal vibrations of the crystal lattice, is proportional to the cubic power of the temperature, while that due to the conduction elec-

Mechanical properties of copper and some of its alloys at low temperature—Table I

Alloy	Condition	Temp., °F.	Tensile Strength, psi.	Yield Strength, psi.	Elong., % in 2 in.	Reduction of Area, %	Izod Impact Strength, Ft. Lb.	Modulus of Elasticity, psi.
Aluminum bronze	Annealed rod	Room	77,300	26,700	26	29	24	—
Al 7.31%		−40	79,700	26,900	35	36	24	—
Zn 1.02%		−112	82,700	27,100	31	30	24	—
Mn 0.44%		−184	88,000	26,600	32	31	21	—
Cu 91.1%		−292	96,100	29,200	29	30	20	—
3% Silicon bronze	¼ Hard sheet	Room	65,000	40,000	50	—	—	16,700,000
Copper 95.8%		−108	72,000	42,000	58	—	—	16,700,000
Silicon 3.1%		−321	91,000	49,000	64	—	—	21,000,000
Manganese 0.86%		−423	107,000	52,000	64	—	—	19,000,000
Beryllium copper	½ Hard sheet	Room	90,000	80,000	15	—	—	17,500,000
Be 1.9%		−108	95,000	87,000	20	—	—	17,800,000
Co 0.21%		−321	117,000	100,000	37	—	—	18,800,000
Si 0.08%		−423	136,000	108,000	45	—	—	19,500,000
Fe 0.07%								
Cu 97.7%								
70–30 brass	Annealed rod	Room	51,000	28,200	49	77	66	16,000,000
(70% copper,		−40	54,700	26,900	58	77	66	—
30% zinc)		−184	61,200	28,000	55	78	70	—
		−292	73,500	29,600	75	73	78	—
60–40 brass	Annealed rod	Room	57,600	—	51	76	8.6*	15,000,000
(60% copper,		−108	61,200	—	53	75	8.6	—
40% zinc)		−297	75,800	—	55	71	8.3	—
(muntz metal)	Cold worked rod	Room	79,700	—	20	66	5.1	—
		−108	82,900	—	21	68	5.3	—
		−297	98,400	—	24	64	5.3	—
Naval brass	Rolled rod	Room	57,200	—	47	51	—	15,000,000
copper 61%		−297	81,100	—	48	48	—	—
zinc 38%								
tin 1%								
Copper	Cold worked rod	Room	58,600	53,500	8	52	—	—
Electrolytic		−108	60,400	58,000	12	57	—	—
		−297	64,700	59,800	11	61	—	—
Copper	Cold rolled	Room	32,000	24,000	46	76	—	17,200,000
	5–7% sheet	−40	37,000	25,000	48	70	—	18,400,000
		−92	38,500	26,500	46	70	—	19,200,000
		−321	52,500	27,000	54	62	—	17,300,000
Copper	Hard drawn rod	Room	52,500	49,000	20	75	—	18,500,000
oxygen free		−108	57,200	55,000	20	80	—	19,700,000
high conductivity		−321	69,000	60,000	35	80	—	20,500,000
(OFHC)		−423	76,000	62,000	55	80	—	21,200,000
80–20 Cupro nickel	Annealed rod	Room	51,500	27,000	26	78	77	20,000,000
		−40	59,600	29,000	29	77	81	—
		−112	61,600	28,900	29	76	79	—
		−184	66,100	29,200	28	75	84	—
		−292	73,700	32,500	36	72	85	—
55–45 Cupro nickel	Annealed rod	Room	60,000	19,600	40	77	81	—
(Constantan)		−40	67,600	21,000	43	78	85	—
Cu 54.36%		−184	77,100	24,100	48	74	83	—
Ni 45.78%		−292	89,600	26,300	57	76	86	—
Nickel silver	Annealed rod	Room	65,000	29,400	47	62	—	18,000,000
copper 64%		−297	83,100	38,200	57	70	—	—
nickel 17%	Cold rolled rod	Room	74,000	69,200	22	54	—	—
zinc 18.7%		−297	93,700	80,500	36	63	—	—
Phosphor bronze "A"	Annealed rod	Room	61,600	—	36	65	—	16,000,000
copper 95.7%		−297	93,200	—	56	58	—	—
tin 4.0%								
phosphorus 0.3%								

* Noted impact value, m-kg./sq. cm.

Summary of temperature effect—TableII

Property	Effect of Decreasing Temperature
Tensile strength	Increases markedly
Yield strength	Increases slightly to substantially
Elongation	Remains the same or increases slightly
Contraction of area	Slight decrease or increase
Hardness	Increases markedly
Impact strength	Slight decrease or noticeable increase
Fatigue strength	Increases
Modulus of elasticity	Increases

Linear expansion coefficients—Table III

Alloy	Temperature Range, °F.	Coefficient of Linear Expansion per °F.x10⁶
Copper	−312 to 61	7.8
Tough pitch copper	−148 to 32	8.7
Copper-nickel Cu balance Ni 29.2% Fe 0.19%	−296 to 32	6.9
Cu balance Ni 49.79 Fe 0.15	−296 to 32	6.7
Constantan	−312 to 61	6.7
Deoxidized copper	−292 to 32	7.9
Free machining brass	−459 to 81	7.3

trons is proportional to the first power of the temperature. In other words, at very low temperatures, the electronic specific heat becomes the controlling factor for the change.

Thermal Conductivity Behavior Varies

With regard to thermal conductivity, copper and its alloys fall into two groups, one where the thermal conductivity increases with decreasing temperature until a peak is reached at some temperature peculiar to the material and then drops off, and the other where the thermal conductivity falls steadily with the temperature.

Table IV shows the effect of temperature on the thermal conductivities of copper and three alloys. All have conductivities of 2,400 to 2,800 Btu./(hr.) (sq. ft.) (°F.) (in.) at room temperature. Three reach a peak of 2 to 35 times this value as the temperature falls and one, phosphorus deoxidized, shows a steady decrease, with no maximum. The magnitude of the increase in conductivity depends on the quantity and type of alloying element. Cuprous oxide, in tough pitch, and cuprous telluride, in tellurium copper, exist for the most part as separate phases in copper with only a very small quantity being in solid solution. The low temperature behavior of phosphorus deoxidized copper indicates that the phosphorus is all in solid solution (dissolved in the copper forming an alloy) and thereby introduces resistance to heat flow.

The thermal conductivities shown in the table clearly demonstrate why copper and its alloys are preferred to other materials in the construction of low temperature heat exchangers.[6] Where the greatest thermal conductivity is desired the commercial coppers arrange themselves as follows in approximate decreasing order: electrolytic tough pitch (electrical conductor and sheet), oxygen free high conductivity copper (OFHC, available as tube sheet, rod and wire), free machining leaded copper (bars and rods), free machining tellurium copper (bars and rods), free machining sulphur copper (bars and rods) and phosphorus deoxidized copper (tube and sheet).[5]

In addition to thermal conductivity, the radiant heat transfer between the walls of vacuum vessels, such as a Dewar flask, is of importance. The heat transferred from an outer vessel wall to an inner vessel at lower temperature is influenced by the surface condition. Experiments with several types of copper and alloys have shown that a freshly reduced smooth copper surface is more efficient in diminishing heat transfer than a highly polished surface of copper.[5, 6] Emissivities of copper and its alloys are increased by roughening or oxidation of the surfaces. Work hardening or films of grease, oil, etc. also increase the emissivity. On the other hand, cleanliness of the surface and lowering of the temperature decreases emissivity or absorptivity of these materials.

Among the factors affecting the electrical resistivity of copper are temperature, cold working and traces of alloying elements. The resistivity is approximately proportional to the absolute temperature but at temperatures below −423F., it approaches a residual value which does not change much with further decrease in temperature. The residual resistivity of electrolytic tough pitch copper (common copper wire) is about 0.2 to 0.9% of its room temperature resistivity. This low residual resistivity of copper at low temperatures has been used to advantage in the liquid-hydrogen cooled electromagnet.[8] Such a magnet requires less than 1/100 the amount of power needed to operate a similar magnet at room temperatures and uses simpler controls. Its disadvantage, of course, is the cost of obtaining the low operating temperature.

Alloys of copper which form a mixture of one or more metals (leaded copper) or copper containing an intermetallic compound (copper plus copper telluride, sulphide, etc.) behave more or less proportionally to the volume composition of the alloy.

The resistivity changes of those aloys which form solid solutions are more complicated. They become even more complicated if an insoluble element, partially insoluble element or precipitable element are added. Generally the resistivities of these solid-solution alloys

(wrought brasses, bronzes, cupro nickels, nickel silvers, etc.) are much higher than those of the individual elements comprising the alloy. The resistance is almost independent of temperature and the residual resistivity at very low temperatures is quite high.

A discussion of the resistivity or conductivity of copper and its alloys is not complete without considering the secondary effects connected with the transport of electricity from one conductor to another. The joining of two different metal conductors at two junctions will form a circuit through which a current will flow when the junctions are at different temperatures. This is well known as the thermoelectric or Seebeck effect. Metals can be arranged in a definite order of potential difference (emf.) produced at a specific temperature difference between each metal and a reference.

A junction which has found wide application is copper-gold containing 2.1 atomic percent of cobalt. This thermocouple has a thermoelectric power of 14.9 microvolts/°C. at − 253 C. (−423 F.). A copper-constantan couple has a power of 5.9 microvolts at the same temperature.

Wide Application in the Cryogenic Field

The use of wrought copper and copper alloys at cryogenic temperatures presents no problems in the metallurgy of these ductile materials. Copper and its alloys are among the most suitable materials for heat exchangers to be used in low temperature gas separation and air separation processes.[8] One type of cold regenerator in a liquid-air oxygen process has copper tubes wound with a ribbon of copper for high heat conductance.

One part of the Riverton, N. J. plant of Air Reduction Co.'s liquid oxygen facilities uses two banks of nitrogen to nitrogen exchangers with one cold shell and one warm shell for the nitrogen cycle. The two separate straight legs of shell are equipped with copper U tubes designed for 2,750 psi. and −250 F. on the tube side and 75 psi. and −275 F. on the shell side. The welding of the copper tubes to stainless steel tube sheets was accomplished by a manual tungsten inert-arc welding technique using an aluminum-bronze filler metal.

Standard copper tubing is used for tube-in-tube type liquid hydrogen transfer lines.[9] Metal bellows are inserted in the outer line to allow for contraction of the inner line on cooling—a 25-ft. piece of copper tubing will shorten 1 in. when cooled from room temperature to −423 F. Copper is often selected for the inner tube of such transfer lines because of its low emissivity. Flexible bronze and copper tubing are also used. It is interesting to note that the marked increase in fatigue resistance at low temperatures receives further confirmation in the behavior of the bellows under operating conditions. A type of bellows which failed after 5×10^3 cycles at room temperature withstood 5×10^5 cycles at −423 F.

Vessels for transporting liquid air, oxygen, nitrogen, hydrogen, etc. are often made with multiple-wall construction using copper or silver-plated copper for the outer surface of the innermost wall because of the low emissivity of these materials.

The apparatus used to obtain practically all of the low temperature data in the tables was fabricated from copper—tubing, sheet, etc. to carry cryogenic liquids to the test specimens and double-walled copper cans to hold the liquids. Copper-constantan thermocouples were used to measure the low temperatures used in the tests.

A new design of electrical switch—a cryotron—consists of a short piece of wire made of a super conducting material around which is wound a control wire. The assembly is immersed in liquid helium (−452 F.) which converts the inner wire to a super-conductor, that is, it now has zero resistivity. A current sent through the outer control coil sets up a magnetic field of sufficient strength around the inner wire to destroy the superconductivity and this shuts off the flow of current into it. Lead is used for the inner wire because it has an imperceptible resistivity below its critical temperature (−446.65 F.). Resistance is so small in the superconducting circuit that a current started by induction will flow, without appreciable diminution, for months. Copper, for reasons not fully understood, does not show complete disappearance of resistivity. The only superconducting copper alloy known at this time is Cu_3Sn which has a transition temperature of −457.36 F.[3]

High thermal conductivity—Table IV

Alloy	Temperature, °F.	Btu. per (Hr.)(Sq.Ft.)(In.)(°F.)
High purity copper	68	2,770
	−279	2,990
	−387	13,900
	−436	97,100*
	−452	48,600
Electrolytic tough pitch copper	68	2,770
	−279	2,990
	−387	6,330
	−414	10,400*
	−452	2,770
Phosphorus deoxidized copper, phosphorus 0.027%	68	2,360
	−279	1,040
	−423	278
	−450	70
Tellurium (free machining) copper, tellurium 0.56%	68	2,430
	−279	2,920
	−414	5,440*
	−441	2,430
	−452	1,040

* peak value

Some of the data in Table I were prepared to fulfill a requirement for design values for a liquid hydrogen-cooled electromagnet. Arthur D. Little, Inc., has reported on the progress in magnetic refrigeration for producing ultra low temperatures which at this stage of development can maintain 0.25 K. The present design consists of a nickel-silver case protected by a resin coating, a central cluster of silver-plated copper fins to collect the heat and a hard packed iron alum filling. The cell is connected to pure lead strips, which can be magnetically switched from conducting to non-conducting.

New Fabrication Techniques Available

Copper tubing is sometimes joined by soft soldering to suitable fittings. Generally a sufficiently long overlap is used in these joints to obtain the strength desired at the operating temperature. Of interest here are the properties of tin and tin-lead solders. Pure tin and all tin-lead alloys containing up to 5% lead are brittle at about −166 F. except for 1 to 1½% lead alloys which give brittle fracture at higher temperatures. Alloys containing more than 10% lead remain ductile at successively lower temperatures as the lead content increases. A 50% tin-50% lead commercial solder is brittle below −238 F. but at this temperature its ultimate strength is increased to 18,500 psi. Solders of higher lead content become brittle only at successively lower temperatures until at about 70 to 80% lead they remain ductile at temperatures down to near the absolute zero. The selection of solder should be made on the basis of operating temperatures for the equipment in question.

Copper alloy joints are usually silver brazed rather than soft soldered to obtain better leak tightness and a greater measure of safety. The copper, copper-silicon bronzes and other copper alloys can be welded or silver alloy brazed. Even with the low melting point brazing alloys the temperature used is high enough to soften or anneal the cold-work-hardened material and the annealed condition usually prevails for brazed and welded joints.

The low thermal conductivity of silicon bronzes and some other alloys tends to localize the effect of heating close to the joint, but with care and the use of copper heat sinks—sometimes water cooled—during brazing one can retain a greater part of the higher strength developed by prior work hardening. Where softening is anticipated and highest strength is desired, the alloy selection should be based on the mechanical properties in the annealed condition. For the fabrication of some parts, the softening resulting from the welding temperatures can be minimized by using, where feasible, special welding techniques such as pressure contact welding, spot welding, etc., or by increasing the gage of the metal in the heat-affected zone surrounding the weld.

A review of the work done on the low-temperature behavior of welded and brazed joints shows that all fused joints between copper alloys and between ferrous alloys made by means of copper alloys improve in their static mechanical properties with decreasing temperature.

The data given in the tables accompanying this article by no means cover all the published data available on copper and its alloys. They have been selected, for the greater part, to give a fairly representative cross section of the commercially available alloys where the data are quite complete. It is hoped that these data and the references will serve as a helpful guide in the selection of materials and in the search for additional data.

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Meet the Author

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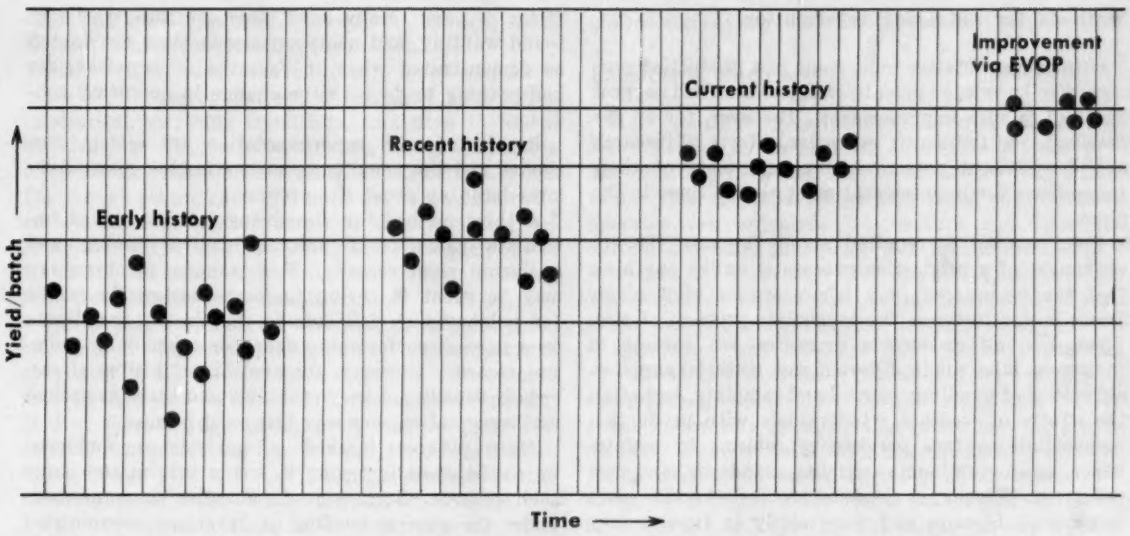


MOST PROCESSES improve with time up to a point—where EVOP can be useful—Fig. 1

Optimize Your Chemical Process With Evolutionary Operations

Experimenting on the plant process without upsetting production. This is EVOP. It forces the process to supply information about itself which is used to evolve a better set of operating conditions.

J. S. HUNTER
Mathematics Research Center, U. S. Army
University of Wisconsin

Evolutionary operation is a method which compels a production process to provide information about itself of immediate applicability without upsetting either production quality or throughput. Properly used, evolutionary operation becomes a regular and integral part of the production process. The method is easy to apply, its results are readily interpreted, and it is sparing in its use of technical manpower and facilities.

Introduced in 1954 by G. E. P. Box at Imperial Chemical Industries in England, it has been used with success in the U. S. by several chemical-processing companies.[1, 2, 3]

The original paper on evolutionary operation was published in 1957.[4] This paper is readily understandable to those with little or no statistical background and should certainly be read by those interested in starting evolutionary operation.

The calculations required are described, in part, at the end of this article. A complete description of the calculations, which have been reduced to simple arithmetic through the use of various approximations, is given in a paper[5] appearing in the new statistical journal *Technometrics*.

Improved industrial processes

In the early history of a process, yields are usually low and subject to much variation. In time, the average yield increases and variation about this average decreases. This gradual improvement can be observed in almost every well run production process. The rate of improvement is the consequence of process studies, information received from laboratory and pilot plant, surveillance of plant records, and occasional chance discoveries. To maintain the same rate of improvement in the future will undoubtedly require investments in research, development and process studies similar to those of the past. One of the purposes of evolutionary operation is to help increase this rate of improvement of the process with only small investments in money and manpower.

Methods for obtaining information

If improvements are to be made in a production process, then knowledge must be obtained that will suggest and lead to such improvements. However, for all the excellent, and frequently expensive, efforts of research and development personnel, the acid tests of their suggestions for improvement must always come in the plant.

Plant testing is required simply because the environment of a production process is unlike anything that can be created in a laboratory or pilot plant. There is, for instance, the immediate problem of size. Then, too, all production processes are subject to variations inherent in different raw material supplies, difficulties of handling, control and sampling, and often the effects of weather. Individuals with production responsibilities face persistent problems in maintenance, production quotas, quality standards, and cost reduction. Finally, as chemical processes become more complex, it is more and more costly in time, money and men, to have the complete chemical and physical details of these processes worked out by research and development.

When a proposal is made to try out a suggestion for improvement on a production process by experimenting in the plant, any of several reactions are likely, and they generally add up to "no." "Leave it alone and be thankful it is working"; or, "No one experiments in the plant"; or simply, "Wait . . . now is not the time."

Experimentation in the plant raises the specter of vast quantities of raw materials being consumed with no resulting saleable product, of flocks of chemical engineers and research personnel climbing about trying to run the equipment, and of management reluctantly setting aside large sums of money for the time and costs of running a production facility as a pilot plant. Nevertheless, this kind of plant experimentation is occasionally conducted in the hope that information obtained will have enough value to quickly offset initial investments. It is experimentation on the grand scale and it can produce valuable information. However, it is obviously an information-gathering method that is expensive, and it entails great risk.

Make small changes

Another way of experimenting in a plant that does not adversely affect production in an obvious manner involves making a very small change in an operating variable and then waiting to see if any beneficial result occurs. The process foreman may try a little less steam in the autoclave, or add a bit more of ingredient A, or speed up the agitator a trifle. Such experimentation often goes on unannounced, with beneficial results proudly "discovered" and those occasional unhappy results hidden under the stairs and blended off. However, the usual consequence of a small change in operating conditions is a small change in the response which, in turn, is lost in the large variations natural to the process. Many good ideas are thus tried and found wanting, and many erroneous ideas are touted as demonstrated when in fact the observed results had nothing to do with the change in operating conditions.

Results of such experimentation are seldom conclusive and the usual consequence is that many folklores build up about the process.

A third method for uncovering information of immediate value to a process involves taking and analyzing plant records. For example, much energy may be spent in trying to locate assignable causes for points which fall outside the three-sigma limits on a process performance chart, or other quality-control records. However, the analysis of historical records is usually not very profitable and there are sound mathematical reasons why this must be so.

Many different methods of analysis are employed by statisticians in trying to wring information from such records. Some statisticians list these methods under the general heading of "practical accumulated records calculations," or PARC analysis. Valuable information does occasionally result from PARC analyses, but it is easy to expect too much from such studies.

Better approach is aggressive

Ideally, what is required is a method for forcing the production process to produce information about itself: information wanted by the production personnel. The process should do this in a regular fashion, and the resulting information should have immediate applicability. Furthermore, information should be obtained without seriously affecting product throughput or quality. If such information can be obtained without large investments of money, or of the time and talent of production managers, so much the better. Evolutionary operation is designed to accomplish just these ends.

What is evolutionary operation?

Evolutionary operation forces the plant process to produce information about itself, without upsetting production, by making a change to a new set of operating conditions.

Generally, these changes are small so their immediate consequence on production is obscured by the usual variation of plant performance. However, by persistently repeating the changes from standard operating conditions to the new operating conditions it is easy to determine which mode of operation is "best." To assist in deciding which set of operating conditions is best, elementary statistical tools can be used. The improved set of operating conditions is then chosen and new, slight but persistent, changes in operating conditions instituted. Thus, while production continues, the plant is forced to produce information about itself and this information in turn is immediately used to evolve the plant to a new set of

operating conditions better than those presently used. Hence the name, evolutionary operation.

An essential idea of evolutionary operation is to make a change, or pattern of changes, away from established operating conditions, and then to repeat the changes. To illustrate why this steady alternation of operating conditions can provide information, a useful, though rough, analogy can be drawn using a radio transmitter and distant receiver. Imagine that the radio receiver is tuned to a very noisy channel, one in which the highs are screeching and the lows booming with considerable and variable energy.

Imagine someone at the transmitter suddenly, and only once, keying on to the channel a faint, continuous constant signal. The presence of such a signal would very likely never be detected by the person listening at the receiver. Suppose, however, that the individual at the transmitter keys in a faint repeating signal, "peep, peep, peep . . . " Then, regardless of the nature and variation of any noise in the channel, the ear of the person listening at the receiver would filter and hear the signal.

This same idea carries over into the production environment. A single small change in operating conditions may slightly increase or decrease the average performance of the process. However, the consequence of such a change is very likely lost in the wide variations and trends in performance that are natural to every production process. But suppose the change is repeated over and over. Then, despite variations and trends of the process, we can gradually become aware of the small differences in performance between the standard and alternative modes of operation, and choose accordingly that operation which appears best.

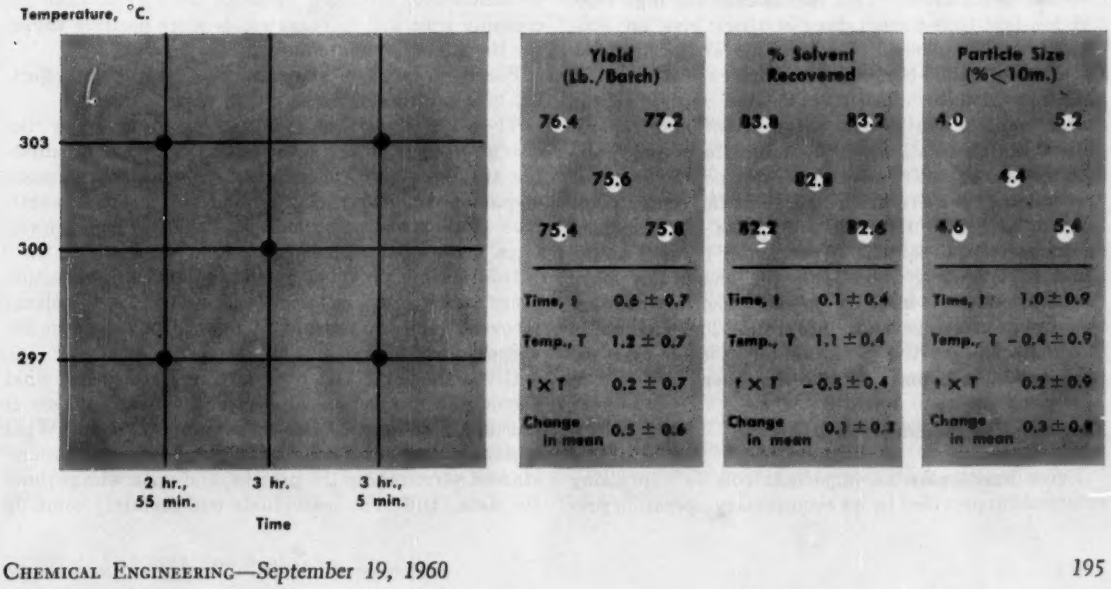
Consider a batch operation

How evolutionary operation works in practice is best demonstrated by an example. Suppose a batch process exists, where one step is an autoclaving operation. Two variables under control of the autoclave operator are autoclave temperature and time the autoclave remains at a prescribed temperature. Three responses are important: (1) yield per autoclave batch, (2) amount of solvent that can be recovered from each batch, and (3) amount of fines in the product.

Experience has indicated that present operating conditions of 300 C. for a period of 3 hr. provides an acceptable product. However, no clear information exists concerning possible alternative operating conditions. Would it be possible, for example, to increase yields without adversely affecting either solvent recovery or fines? Past experience shows that variations of ± 3C. and ± 5 min. are not dangerous or obviously injurious to the process. In fact, variations of this order of magnitude are well within the usual operating tolerances encountered in the plant.

A planned cycle of operating conditions for time and temperature illustrated in Fig. 2, is started in the plant. These five sets of operating conditions comprise a cycle of the evolutionary-operation program. One batch is run at each of the five operating conditions, and all runs are completed within a cycle before the next cycle begins. Individual points comprising the cycle are numbered for reference and computation purposes and do not indicate the order in which the

Information board tabulates time, temperature effects—Fig. 2



trials are run within a cycle. It is best, though not absolutely essential, that the runs be made in a random order within a cycle. A second series of batches at the same operating conditions shown in Fig. 2 will comprise another cycle.

Information provided by this evolutionary-operation program is displayed after each cycle on an information board. A detailed explanation of the calculations required for the information board are given in the example at the end of this article, and more completely in Ref. 5 Only simple arithmetic is required. Briefly stated, the average response is computed at each of the points comprising a cycle at the end of each cycle. These averages are then used to estimate time and temperature effects, time by temperature interaction effect, and change in mean effect. To illustrate, these estimated effects with their error limits are given on the information board in Fig. 2 for 7 cycles and 3 responses.

What the effects mean

Main effects estimate the change in response to be anticipated as the corresponding controlled variable is shifted from its low to high setting. In the above example, the main effect of time, for the yield response, equals 0.6 units. Thus, as the time of reaction is changed from 2 hr. 55 min. to 3 hr. 5 min. yield is estimated to increase by 0.6 units. Similarly, shifting temperature from its low to high setting gives an estimated change in the response of 1.2 units.

Interaction effect is a bit more difficult to interpret. It measures the failure of the main effect of one variable to remain constant as the second variable is changed. Viewed another way, it measures the increase or decrease in the response resulting from the simultaneous effects of the controlled variables over and above that which can be accounted for by the simple addition of the main effects. In the example, the time by temperature interaction effect for the yield response is 0.2 units. This means that the high-high and low-low time-temperature settings give an estimated increase in yield of 0.2 units over the high-low and low-high time-temperature settings.

Change in mean effect is calculated only when the center point is run as part of an evolutionary operation cycle. Calculations of the main effects and interaction effect do not require the center point. It measures whether the average response at the center point is lower or higher than the average of the responses at the peripheral points. If the center point is at the standard operating conditions, the change in mean effect provides a measure of the cost of running the evolutionary-operation program. The change in mean effect is positive if the center is lower than the peripheral points and negative if higher.

Error limits include true value

Error limits play an important role in appraising information provided by an evolutionary-operation program. Effects which are calculated from the data are called point estimates of the true effects of the controlled variables. These point estimates cannot equal the true effects because they are computed from individual observations which are known to be subject to errors. Error limits provide a reasonable and conservative range for the likely values of the true effects. Values included within these bounds give an interval estimate for the true effect. A wide interval expresses the fact that the information possessed by the data is slight relative to the true effect. A narrow interval connotes that the true effect is known with considerable precision. The width of an interval is a function of the variance of individual observations, a large variance providing wide intervals.

Interval estimates are usually wide during the early stages of an evolutionary-operation program. However, with increasing number of cycles the interval range tends to become smaller. The interval may occasionally expand slightly due to unique variations in the observations, but in the long run it must decrease. Hence, knowledge of the nature of the true effect becomes known with greater and greater precision as the number of cycles increases.

Review the information board

Confining our attention to information on the yields of product in lb./batch, it is of some interest to review the results given on the information board in Fig. 2.

The interval estimate for the temperature effect is 1.2 ± 0.7. This is a very strong signal for it seems clear that increasing the temperature from 297 C. to 303 C. will certainly increase the yields, although the amount of the increase is not too well known. We would not be surprised for example if the yields were increased by as much as 1.8 lb. batch, or by as little as 0.6 lb. batch. Both these changes in yield are within the error limits for the temperature effect.

The information on effect of time, 0.6 ± 0.7, is not as conclusive, although evidence does exist that increasing time will increase yields since positive values for the effect dominate most of the interval.

Based on present evidence, the interaction effect, 0.2 ± 0.7, could easily be either plus or minus.

There is a fairly strong signal concerning the change in mean effect, positive values clearly dominating the interval. This is good evidence that present operating conditions of 3 hr. and 300 C. are not optimum with respect to yields, and that a change away from these operating conditions is desirable.

Information provided by the evolutionary-operation program with respect to the other responses, % solvent recovered and the amount of fines, should also be reviewed.

Given the information on all three responses, what should the production supervisor do next? There is no simple answer to this important question. What is done with the information depends on local circumstances surrounding the process, and upon who reviews the data. Different individuals will certainly come up

with different decisions. For example, viewing the information board in Fig. 2, a production supervisor might decide:

- That the estimated effects, while interesting, still do not possess sufficient precision, and thus to continue the program for several more cycles;
- To begin a new phase of evolutionary operation about a higher time and temperature, or at a higher temperature and over the same time interval, or at a higher temperature and perhaps over a wider time interval;
- To begin a new phase with new controlled variables replacing either or both the time and temperature.

The decision to continue the present program, or to change to a new phase of evolutionary operation, depends not only on the information provided by the present evolutionary-operation program, but also upon the production supervisor's prior knowledge concerning the process, and his immediate production problems.

Information gathering and decisions

In interpreting interval estimates, the question is often raised, "Why doesn't the production supervisor follow the principal response and simply wait until the value zero falls outside the interval estimate before deciding that changing operating conditions is worthwhile?" (Statisticians will recognize this rule of operation as merely waiting until the estimated effect is found to be statistically "significant" from the zero value.)

To wait for zero to fall outside the interval estimate is a very inefficient use of the information provided by evolutionary operation. The most important objection to such a mode of operation is that it cuts out the interpretive role of the production supervisor. After all, the interval is based only on the humble set of numbers that have been gathered by the evolutionary-operation program. These numbers are important, and they do reflect unprejudiced information about the process. However there are large reservoirs of information germane to the process that these numbers cannot possibly possess. This knowledge is in the minds of the men who know the process best. Certainly decisions should be based on the *sum* of knowledge available at any point in time. Ignoring additional information, and using a go-no-go rule based on numerical information alone, slows progress.

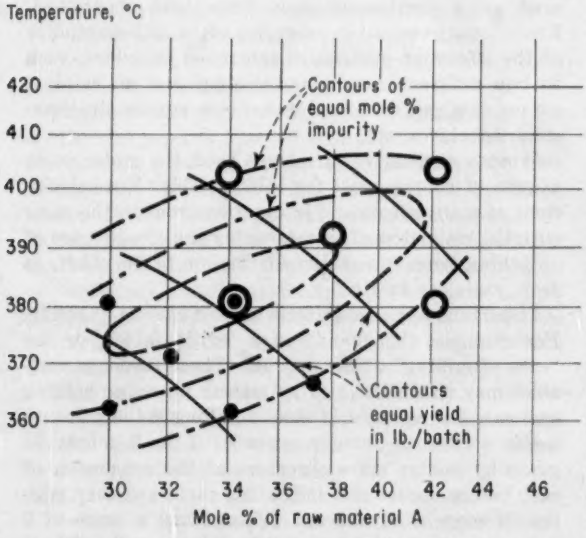
Evolutionary operation brings information out from the production process, clearly and regularly. Its proper function is that of an information producer, and not of a decision maker.

Can't replace knowledgeable personnel

When several responses are followed simultaneously in an evolutionary-operation program, any go-no-go decision criteria can become quickly unmanageable. Diametrically opposite signals will frequently occur. Suppose, in the above example, it is discovered that decreasing the temperature increases the yields, but decreases the solvent recovery. What would the production supervisor do now? His decision would depend upon the relative importance of increased yields vs. losses in solvent recovery. Such a decision would certainly have to consider costs, convenience, equipment, etc. He would have to weigh the alternatives, and his choice of weights would be a function of information found not in the data, but in his mind based on his experience.

It should now be clear that the appraisal of evolutionary-operation programs belongs to men who know the circumstances surrounding the process best. Evolutionary operation is a production tool, to be run and managed by production men. This is not to say that the personnel from development, research, quality control, sales, etc., cannot or should not have a part in the over-all operation and direction of an evolutionary-operation program. In the original paper, George Box proposed that an evolutionary-operation committee be formed to regularly bring non-production men up-to-date with the program, and to give them an opportunity to review the evidence in the light of their knowledge. In this fashion, additional valuable ideas may be uncovered. Good practice dictates, however, that evolutionary operation, to be successful, belongs in the production environment under the control of individuals who have plant-production responsibilities and knowledge.

Contour map shows way to optimum—Fig. 3



SOLID lines indicate contours of equal yield; yields increase going from left to right. Black dots are settings from the first test phase, circles are data from the second phase.

Maps show process characteristics

Data from different phases of evolutionary operation frequently can be combined to provide rough maps to indicate how a response varies as the controlled variables are changed. In the following example, the two controlled variables are temperature and mole % of raw material A. Two responses are yield of end product in lb./batch and mole % impurity.

Contour diagrams showing how responses change for different settings of the controlled conditions are given in Fig. 3.

Data which provided these maps were obtained from two successive phases of an evolutionary-operation program. On viewing Fig. 3, it is clear that minimum impurity is found when the process operates around 380 C. with 34 mole % of A. If product can be sold that contains more impurity, then to give highest yields the plant should be operating with temperature around 395 C. and 41 mole % of A. If plant conditions suddenly force us to operate at a temperature of, say, 370 C. it is easy to see how A should be changed for yield or impurity.

Clearly, information of considerable practical value has come from these two evolutionary operation phases. The exact statistical estimation of the contour maps does require some training and study. However, surprisingly good maps can frequently be obtained by merely recording the average performance at each setting of operating conditions, and then sketching in the contours free-hand.

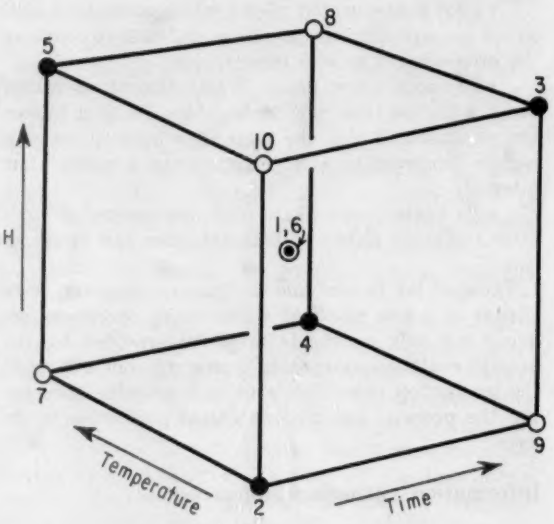
Three-variable programs

Three controlled variables can be readily studied simultaneously in an evolutionary-operation program. The proposed pattern of minor variants from standard operating conditions gives the vertices of a cube when viewed geometrically as illustrated in Fig. 4 for the case of the controlled variables time, temperature and pH.

Runs comprising the full cycle are usually broken into two groups or blocks, the runs in each block comprising the vertices of a tetrahedron plus a center point. The two tetrahedra comprising the cube are shown using open and closed dots in Fig. 4. Operating conditions are then run randomly within each block (tetrahedron), the two blocks completing a cycle. (The cycle of variations may, as in the two controlled variables case, be run with or without the center point.) Calculations associated with a three-variable program are nearly identical with those for a two-variable program, and are explained in some detail, with illustrations, in Ref. 5.

Experience has shown that most evolutionary-operation programs begin by studying the effects of two controlled variables and then quickly move on to studies of three controlled variables. It is theoretically possible to study any number of controlled variables simultaneously. Experimental designs and methods of analysis for these larger number of variables are available.

How to handle a three-variable study—Fig. 4



However, it must be remembered that evolutionary operation is to be conducted in a production environment, and experience has shown that two- and three-variable programs are most easily managed.

Qualitative variables and responses

Thus far, only controlled variables that can be measured on a continuous scale have been mentioned. Evolutionary-operation programs often include studies of the effects of qualitative controlled variables, such as two different raw material suppliers, no catalyst versus catalyst, soft-steel autoclaves versus stainless-steel autoclaves, etc.

When a qualitative variable is used, the center point cannot, of course, exist for this variable. But calculations of main effects and interactions remain the same with the estimated effect measuring the consequence of switching from one quality distinction to the other, as from stainless to steel.

Important response criteria are not easy to quantify. For example, the "hand" of a textile fabric, or the "ease of milling" of the product. These response variables may also be studied by setting up rough scoring systems. For example, if ease of milling is the response under study, an integer score of 1 to 5 might be given by one or more observers at the conclusion of each batch, a score of 1 indicating rapid and easy milling; a score of 3, average milling; and a score of 5 indicating the batch was difficult to handle. These scores, as they are averaged over many cycles, acquire the aspect of continuous measures, and differences in handling can thus be determined.

Some questions and answers

In discussing evolutionary operation, many questions arise. Attempts to answer a few of these will now follow:

• Who should have responsibility for the information board? The information board has a vital role in evolutionary operation. It provides a quick visual picture of what is going on in the plant. It should therefore be immediately available to production personnel and should be maintained by them if at all possible.

It is an error, in the view of the author, to separate a man from his data. The principal reason for composing the calculation work sheets, and abbreviated methods given in Ref. 5, was to keep the data, and their analysis, on the production floor.

In one evolutionary-operation program at the American Cyanamid Co., the information board is kept on the large pane of glass that separates the office of the production supervisor from the actual production line. The supervisor, on looking up from his desk at the process, literally looks through the board. The data produced by the process are always before his eyes.

At the Chemstrand Corp., several of the three variable evolutionary-operation programs use a grid in the form of a cube and constructed from short steel rods. At each of the vertices of the cube small paper clips hold cards on which the current average process performance is given for the corresponding set of operating conditions.

These "sputniks," as they are termed by the local personnel, provide a regular picture of what is going on in the plant relative to the variables under study. The information board should be kept where it can be readily seen, and it should be made as dramatic as possible to the eye through the use of colors, etc. The eye is a very broad information-bearing channel to the mind and should be resourcefully used.

• Can evolutionary operation be used on a continuous process? Yes, certainly.

The most convenient device is to artificially turn the continuous process into a batch process by assigning the product produced over a certain interval of time to a batch. The length of the time interval should be chosen so that any transient performance occurring as the result of a change from one set of operating conditions to another is damped out. Fortunately, good estimates are usually available as to how long a time period is required. The yield for the batch is then the average of the last three or four sample results within the time interval.

Much vigorous investigation is presently underway on methods of continuous control and operation of continuous processes. Evolutionary operation presents an economical and useful means for getting information out of many such continuous processes.

• Should we attempt to reduce the variance due to sampling and analytical methods before beginning evolutionary operation? When the variance of the observations is high, which may be due in part to errors of sampling and analysis, then the number of repetitions required before a shift in average performance can be detected is correspondingly high. This is a strong law and cannot be avoided.

However, a production process goes on day after day and supplies a superb opportunity for repetition. Evolutionary operation takes advantage of this fact, and provides about the only immediate hope for securing information from processes where the variance is high.

To begin an evolutionary-operation program before improved sampling and analysis are available simply means that more cycles will have to be run before signals can be detected. Certainly, such programs will add an impetus for improved sampling and analysis. It should also be remembered that the present process is not likely to be around for long. Due to the dynamic nature of industry, new equipment and entirely new modes of manufacture will probably displace most present processes before they are too many years old. The important question is, "What can we do now to improve the present process?" Evolutionary operation can help supply some of the answers.

• How does evolutionary operation differ from quality control? For the purposes of information gathering, quality-control methods are passive. The principal tool is the three-sigma process performance chart, which provides a visual record of the time history of the process. Investigations of unusual events noted on these charts occasionally do uncover ideas useful for improving the process. These investigations, however, await the accidental event and consist mainly of a search for assignable causes. Evolutional operation, by inserting minor pre-planned variations into plant operation, compels the plant to produce the information wanted. For the purpose of information gathering, evolutionary operation is aggressive. This does not mean that one replaces the other. The purposes of quality control and evolutionary operation are basically different, but certainly complimentary.

Most of the calculations for EVOP involve simple mathematics. However, some statistical interpretations are necessary. The sample calculation which follows is intended to give some idea of what is involved without going into any lengthy discussions of statistical techniques.

Only the condensed calculation procedure for a two-variable program will be reviewed here. For complete details on the calculations for both two- and three-variable evolutionary-operation programs, the reader is referred to Ref. 5.

Typical data from a plant study—Table I

Cycle Number	Run Number				
	1	2	3	4	5
1	17	11	23	14	17
2	15	13	19	14	15
3	13	12	18	17	16
4	19	12	28	11	16

The experimental design and controlled variables used in this example are those shown in Fig. 2. At the end of the fourth cycle, suppose that sets of observations have been recorded at each point of the cycle as in Table I.

Note that each set of conditions, a temperature and time, has a run number assigned to it, but these numbers do not necessarily indicate the order in which each run is made. In fact, the runs should be made in a random order for each cycle.

Calculation of effects

A calculation work sheet has been prepared to assist in obtaining running averages, estimates of the effects, and error limits. The first portion of the calculation work sheet, at the end of cycle four, is shown in Table II.

The new running averages are recorded on the information board in their correct positions as illustrated in Fig. 5. The effects are computed using these averages by direct substitution below. Thus, at the end of the fourth cycle the estimated effects are:

$$x_1 \text{ effect: } \tfrac{1}{2}(y_3 + y_4 - y_2 - y_5) = 4$$
$$x_2 \text{ effect: } \tfrac{1}{2}(y_3 + y_5 - y_2 - y_4) = 6$$
$$x_1x_2 \text{ effect: } \tfrac{1}{2}(y_3 + y_2 - y_4 - y_5) = 2$$
$$\text{Change in mean effect: } (1/5)(y_2 + y_3 + y_4 + y_5 - 4y_1) = 0$$

The x_1 effect in the equation is the time effect in our example, x_2 represents temperature, while x_1x_2 indicates the time-temperature interaction.

These effects are recorded, for cycle 4, on the information board as shown in Fig. 5.

We now have to determine the error limits for each of these effects.

Sample calculations for EVOP evaluation—Table II

Operating Conditions ⟶	(1)	(2)	(3)	(4)	(5)
(i) Previous cycle sum	45	36	60	45	48
(ii) Previous cycle average	15	12	20	15	16
(iii) New observations	19	12	28	11	16
(iv) Differences, (ii) less (iii)	−4	0	−8	4	0
(v) New sums	64	48	88	56	64
(vi) New averages: y_i =	16	12	22	14	16

Lines i, ii, iii, iv, v, vi are filled in as follows:

Line (i)
Write down the running sum at each point from the previous cycle.

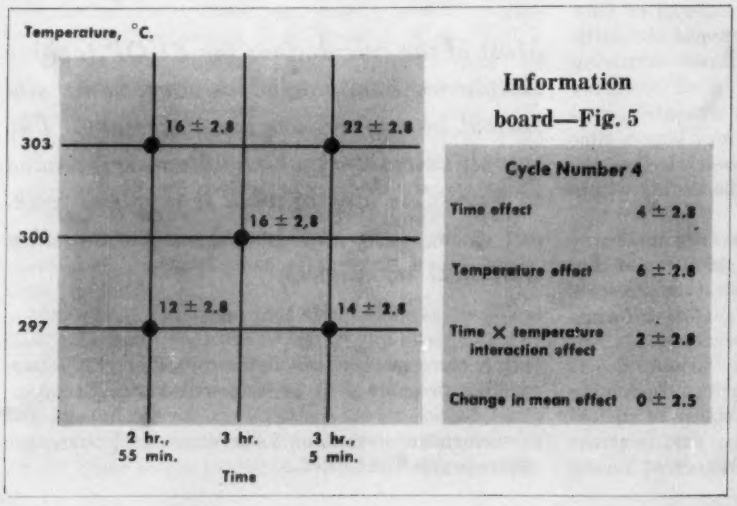
Line (ii)
Write down the corresponding running average at each point from the previous cycle.

Line (iii)
Directly beneath the running averages write down the single observation obtained at each point during this cycle.

Line (iv)
Record the difference between the previous average and the present observation for each point.

Line (v)
Compute the new running sum at each point.

Line (vi)
Divide each sum by n, the cycle number, to obtain the up-to-date running average.

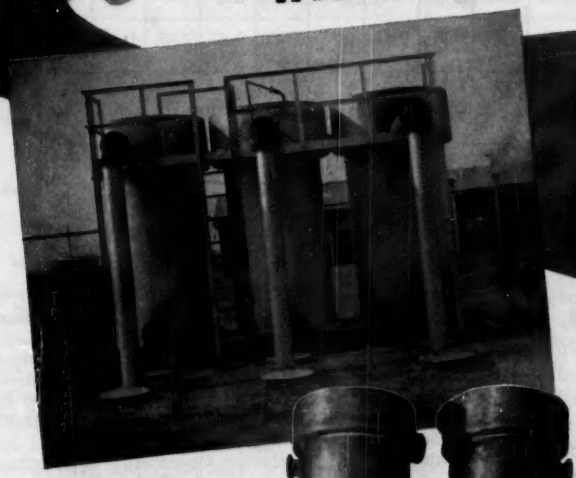


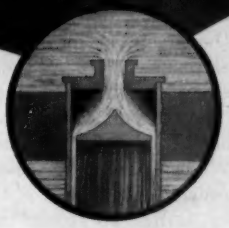
Information board—Fig. 5

Cycle Number 4	
Time effect	4 ± 2.8
Temperature effect	6 ± 2.8
Time × temperature interaction effect	2 ± 2.8
Change in mean effect	0 ± 2.5

LOW HIGH HEAT TRANSFER RATE with LOW PRESSURE DROP

Vogt





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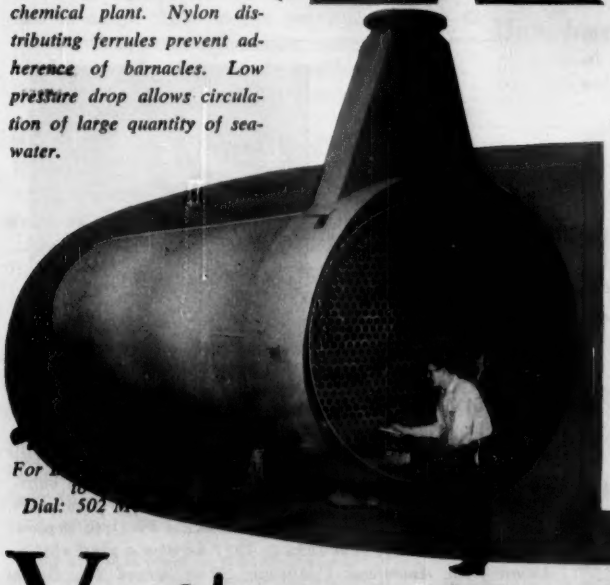
TOP: *Muddy well water is the coolant for these Jacket Water Coolers.*

RIGHT: *Two 56" Dia. x 12'0" high Amine Solution Coolers with expansion joints in shell.*

BOTTOM: *One of a number of seawater cycle units for a chemical plant. Nylon distributing ferrules prevent adherence of barnacles. Low pressure drop allows circulation of large quantity of seawater.*



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Values of $f_{k,n}$ for estimating standard deviation—Table III

k*	n† 2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
4	0.34	0.40	0.42	0.43	0.44	0.45	0.46	0.46	0.46	0.46	0.47	0.47	0.47	0.47	0.47	0.47	0.47	0.47	0.47
5	0.30	0.35	0.37	0.38	0.39	0.40	0.40	0.40	0.41	0.41	0.41	0.41	0.41	0.42	0.42	0.42	0.42	0.42	0.42

* Number of sets of conditions in a cycle. † Cycle number.

Calculation of error limits

As discussed earlier, one's ability to interpret the estimates of the effects depends on the relative magnitudes of the estimates and upon their error limits. To determine the error limits, an estimate of the standard deviation of the individual observations is computed at the conclusion of each cycle, beginning with the second cycle. The average of these estimates, multiplied by appropriate constants, is then used to determine the error limits. To reduce the computations to their simplest form the range of the differences recorded in line iv of the calculation work sheet is used to obtain the estimate of the standard deviation for this present cycle. The remainder of the calculation work sheet, at the end of cycle four, is:

(vii) Range of entries in line (iv) 12
(viii) New s = (Range) $(f_{k,n})$ = 12 (0.37) = 4.4
(ix) Previous sum s 3.9
(x) New sum s 8.3
(xi) New average s = (New sum s)/$(n-1)$ = 2.8

The values of $f_{k,n}$ used to multiply the range to provide an estimate of the standard deviation are given in Table III. This table is abridged from a larger table found in Ref. 5.

In this example there are $k = 5$ sets of operating conditions in a cycle. At the end of cycle four, $f_{5,4} = 0.37$. If the center point had not been run as part of this evolutionary-operation program then $k = 4$.

Using the estimate of the standard deviation for individual observations $s = 2.8$, the error limits for the running average and the various effects are given:

Error limits for running averages, main effects and interaction

$$= \frac{\pm 2s}{n^{1/2}} = \frac{\pm 2\ (2.8)}{4^{1/2}} = \pm 2.8$$

Error limits for change in mean effect

$$= \frac{\pm 1.78s}{n^{1/2}} = \frac{\pm 1.78\ (2.8)}{4^{1/2}} = \pm 2.5$$

These error limits are approximate. However, the approximation is reasonable, and after three or four cycles varies only slightly from the exact error limits. The effects with their error limits are also displayed on the information board given in Fig. 5.

On review of this information board, there is very strong evidence that increased yields will occur if the temperature and time are both increased.

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Meet the Author

J. S. HUNTER *is a member of the mathematics research center, set up by the U. S. Army at the University of Wisconsin in Madison, Wis. He has worked closely with Dr. G. E. P. Box on the development of evolutionary operation as well as other statistical techniques. An electrical engineer (B.S.) from N.C. State College, Mr. Hunter also holds an M.S. in engineering mathematics and a Ph.D. in experimental statistics. From 1954 to 1957 he was a staff statistician with American Cyanamid, then joined Dr. Box's statistical group at Princeton. Dr. Hunter is editor of the new statistical journal* Technometrics, *published quarterly by the Amer. Society for Quality Control and the Amer. Statistical Assn.*

Measuring and Controlling Costs

Increased maintenance will increase plant on-stream time and reduce total plant costs—up to a point. Beyond that point, increases in maintenance only increase costs.

RAYMOND I. REUL *Food Machinery and Chemical Corp.*

Problems confronting management regarding the study and control of the maintenance function are quite different and far more complex than those encountered in production activities. We can demonstrate that the standard accounting and industrial engineering techniques, used so successfully to study and evaluate production performance, are seldom suitable for direct application in maintenance.

This does not mean that these standard approaches cannot be used at all—many will be found useful, but not if they are applied blindly in exactly the same manner as they are in production management.

If these techniques are first modified to adapt them to the peculiar nature of maintenance needs, many of them can be successfully applied to the study and control of maintenance costs.

▶ **"Maintenance Departments"** — Every industrial enterprise must provide for the routine fixing or repairing of its facilities. Usually a group of employees, who specialize in this type of activity, is organized into a single service pool to perform this work for the entire plant. This segment of the plant organization is generally labeled "Maintenance Department."

If work performed by these employees were limited to this fixing or repairing activity, management's task in connection with this function would be greatly simplified. But this, however, is seldom the case.

To develop a rational plan of attack, we must segregate the work performed into the three basic categories involved:

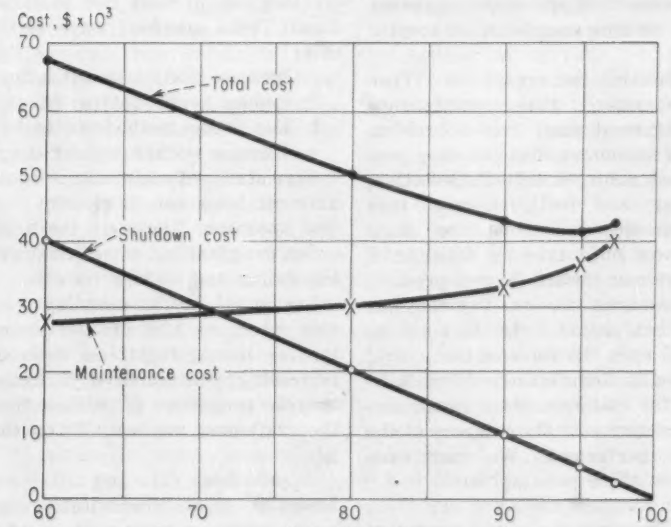
1. True maintenance is work done to keep existing facilities in condition to function as originally installed. It includes repairs, routine servicing, emergency action, housekeeping (including painting) and replacements (even when charged to the capital account).

2. Project maintenance is improvement work done in connection with existing facilities which can be justified job by job, on the basis of the results to be achieved. This would include additions, modifications, re-arrangements, removals and demolitions, and so forth.

3. Service activities usually include work scheduled on a continuous basis by the year, rather than job by job, and provide services rather than a product. The work usually does not require the use of craftsmen. Examples are operation of utilities, plant protection, shipping and storeroom operation.

In each of these categories, the basis for measurement of ultimate performance is entirely different.

How increased maintenance affects costs



This article is based on a paper that was presented at the Tenth Annual Industrial Engineering Conference held at West Virginia University in 1959 and at the American Association of Cost Engineers convention in June 1960 at Houston.

Maximum maintenance not always optimum—Table I

Current Data for 100-Day Period

Operating cost exclusive of maintenance and material $100,000
Maintenance cost $30,000
Present performance ..... 80% on-stream time
Assume that 10% increase in maintenance will halve down time.

On-Stream Time	Maintenance Cost	Shut Down Cost	Total Cost
60%	$27,300	$40,000	$67,300
80*	30,000	20,000	50,000
90	33,000	10,000	43,000
95	36,300	5,000	41,300
97½	40,000	2,500	42,500

* Present operating level.

For this reason, we can conclude that any system for effective performance measurement must provide for segregation of costs into these three categories and also provide separate, independent management control techniques.

▶ **How They Operate**—In a way, the operation of a "Maintenance Department" can be likened to the operation of a manufacturing "job shop." As in a job shop, there is a pool of manpower and facilities. With the exception of service activities, work is organized into specific, limited jobs. Work to be done in connection with each job is individually planned and scheduled. The work force and facilities are allocated as needed and the objective is use of manpower and equipment consistent with on-time completion of specific tasks.

However, in regard to "True Maintenance" work, maintenance management must face a problem never encountered in job shop production management—the selection, timing, and justification of true maintenance jobs to be done. Management must take the attitude of a customer toward its own product, maintenance service. Decisions as to what should be done must be based upon the value of the job.

▶ **How to Reduce Costs**—Possibilities for cost reductions in maintenance vary with the category of the work performed. We may summarize these possibilities:

True Maintenance

1. Decrease the cost of work that must be done.
2. Reduce the quantity of work done to attain the same objective.
3. Reduce mill cost (by better maintenance that costs less than the reduction achieved in other mill costs).

Project Maintenance

1. Decrease the cost of work that must be done.
2. Eliminate work that cannot be economically justified.

Service Activities

1. Decrease the cost of work that must be done.
2. Eliminate work that cannot be economically justified.

You will notice that one action is possible in all three categories: decreasing cost of work that must be done. There are four ways to do this:

1. Increase manpower utilization.
2. Reduce nonproductive effort.
3. Use better methods or tools.
4. Increase worker productivity.

Five standard maintenance management tools can implement the first approach. These are the work order, pre-planning, pre-estimating, scheduling and backlog records.

Statistical work sampling can help determine how effective maintenance management has been in increasing productivity. It measures the proportion of the time that the craftsmen are actually on the job.

Approaches (2) and (3) are basically work simplification or method improvement and require job by job studies.

Approach (4) refers to the use of standards and incentives to produce a self-policed increase in individual productivity.

The remaining possible actions are peculiar to the work category involved. Under true maintenance we have two additional possible actions:

First, reduce the quantity of work that must be done to attain the same objective. To do this, we can eliminate unnecessary work, improve quality of workmanship, take preventive action, reduce equipment abuse and improve equipment design.

Records are a valuable maintenance management tool for documenting results in this area.

Second, reduce mill cost (by better maintenance costing less than the reduction achieved in other mill cost). Of late, there has been considerable emphasis on the point that the objective of maintenance should be lower total mill cost (total cost of manufacturing including maintenance) rather than just lower maintenance costs. The argument is that greater maintenance effort (at higher cost) may actually result in lower total cost.

But be very sure that the improved maintenance actually yields a reduction in total costs. There often is an optimum point beyond which the yield from increased maintenance effort is less than the additional expense.

One of the advantages most frequently claimed for improved maintenance is reduced down time. The graph on p. 203 illustrates a case where the optimum maintenance level is that yielding about 92½% on-stream time. Table I shows the hypothetical data and calculations from which the curves in the graph were drawn. You will note that the assumptions in this example were very optimistic. We postulated that every 10% increase in maintenance cost would halve remaining down time. Despite this rather unrealistically favorable supposition, you can see that increasing on-stream time above the optimum of 92½% on-stream time merely increases total mill cost.

Other benefits claimed for in-

Monthly report compares expenditures—Table II

Current Month			Cost Items	Year to Date		
Actual	Budget Allowance	Spending Variance[1]		Actual	Budget Allowance	Spending Variance
$ 300	$ 250	$ 50	Administrative	$ 2,200	$ 2,000	$ 200
1,400	1,400		Supervisory	11,200	11,200	
250	250		Clerical	2,000	2,000	
19,300	15,000	4,300	Labor	152,360	120,000	32,360
800	800		Other	12,310	6,400	5,910
$22,050	**$17,700**	**$4,350**	**Total payroll**	**$180,070**	**$141,600**	**$ 38,470**
$11,500	$10,000	$1,500	Operating	$ 71,300	$ 80,000	$ −8,700
2,000	2,300	−300	Spread	18,500	18,000	500
13,600	15,000	−1,400	Consumed	118,950	120,000	−1,040
$27,100	**$27,300**	**$ −200**	**Total supplies**	**$208,760**	**$218,000**	**$ −9,240**
$49,150	**$45,000**	**$4,150**	**Total Department**	**$388,830**	**$359,600**	**$ 29,230**
$8,750	$7,000	$1,750	Contract payments	$ 32,890	$ 28,000	$ 4,890
$57,900	**$52,000**	**$5,900**	**Total expenditure**	**$421,720**	**$387,600**	**$34,120**
		$3,960	Volume variance[2]			
		$9,860	**Total variance[3]**			

1. Spending variance = budget − actual expenditures
2. Volume variance = actual absorption − budget
3. Total variance = actual absorption − actual expenditures

creased maintenance effort include improved quality of product or service, improved yield (or less scrap, rejects and off-grade), less direct labor (reduced attention time), and improved safety.

Project maintenance provides a quite different picture. We can eliminate work that cannot be economically justified. This is a job-by-job problem.

To take effective action in this area we need accurate job cost estimation, reliable and realistic predictions of the advantages to be realized from the job and an effective evaluation technique.

Each project maintenance job is really an individual investment proposal that should be justified on the basis of predicted return. But a word of caution: reduced project maintenance expenditures, through rejection of jobs that are economically justified, can lead to undesirable consequences.

Under service activities, we also have the possibility of eliminating work that cannot be economically justified. In this case, however, long term plans rather than job by job studies are indicated, and the figures to be evaluated are those of alternative continuing costs. Investment considerations are seldom involved.

▶Give Maintenance Its Due—Maintenance has grown to be a major function. It is rapidly coming of age and is coming to be recognized as a true profession. Despite this, production management, long used to regarding maintenance as a "flunky" department, is often reluctant to accept this situation. This reluctance can be noted in:

1. Resistance to the assignment of full responsibility for true maintenance to the maintenance department. There still is a strong tendency to hold production supervision accountable for individual departmental maintenance costs.

2. Insistence upon considering the writing of work orders for true maintenance as the prerogative of production supervision with maintenance supervision limited only to the performance of the work requested.

3. Continued use of departmental maintenance or utility men under direct supervision of production supervisors.

The situation in regard to project maintenance is quite different. The decision to do or not to do a project job is a plant management assignment. This decision can be delegated as seen fit, including to the maintenance department, but is basically a plant management responsibility.

▶How Costs Are Incurred—Each category of maintenance costs is incurred in a different fashion. Neither project maintenance nor service activities can be related to productive output. True maintenance can be related to productive output but this relationship has some peculiar aspects. For example:

- Total expenditures of the entire maintenance department (exclusive of work diverted to independent contractors) will tend to remain relatively constant from month to month, the amount of effort in each of the three categories being shifted to match available work capacity with the balance, if any, absorbed by increasing or decreasing work backlog.
- On an average, the need for true maintenance will accrue at a constant rate or combination of rates which may be related to calendar time, operating time or production throughput.
- Over short periods of time, such as one month, actual expenditures for true maintenance will seldom parallel the pattern of average need. One reason for this is that the need for true maintenance tends to be cyclic rather than uniform, with peaks occurring when cycles coincide. Another reason is that the actual performance of required work can be and often is delayed or advanced in accordance with the availability of manpower and equipment downtime. Still another reason is the occurrence of emergencies at irregular intervals.

▶A System for Controlling Costs

We will describe a budgeting and cost system designed to yield a basis for effective planning and control

of current costs, and to provide a basis for finding, evaluating and demonstrating the results of specific cost reducing actions.

This combination of techniques must provide reliable spending predictions for financial management and realistic predictions for comparison with actual performance. These predictions should be as free as possible from "built in" variances.

In addition, the system should provide a basis for prompt corrective action, rather than an historical record, and a framework for predicting and evaluating the results of cost reduction efforts.

In practically all cost systems today, reports are issued at the end of comparatively short "cost periods" that vary from one week to 90 days. The most frequently used period is one month. In all cases, the length of one period is far too short to develop a meaningful pattern of true maintenance costs. We can safely assume, however, that the total cost of the maintenance department (exclusive of contract expenditures) will be relatively constant and predictable from month to month.

Table II represents the maximum detail we can build into a monthly presentation without building in unpredictable variances due to the system.

▶ **Some Definitions**—Budget predictions are called "budget allowances." The difference between "actual" cost and the applicable "budget allowance" is called the "spending variance." Products are absorbed into inventory at "standard unit costs." A given amount of production earns a certain amount of maintenance "credit." This credit is calculated by multiplying the production volume of each product by its unit maintenance cost allowance and totaling for all products. The total maintenance cost credit minus the total budget allowance is called the volume variance. The figure is seldom significant but is shown merely to balance the books as required by accountants. The total variance, the difference between total maintenance credit and total actual expenditures, is equal to the "spending variance" plus the "volume variance."

You will note that Table II gives no breakdown of expenditures by category nor is there any comparison by consumption points (cost centers, departments, etc.). This is because, as we have already stated, such breakdowns cannot be reliably predicted for short periods of time and comparison of these details would have no meaning. So why make them.

However, we do need, and can justify collecting, a cumulative record of costs broken down both by category and use point.

▶ **Preparing the Maintenance Budget**—The first step is negotiation and agreement between the maintenance superintendent and the foreman of each cost center as to how much true maintenance will be required in each cost center. The next step is negotiation between the production and maintenance superintendents on how much, where and at what cost project maintenance jobs will be assigned to maintenance. Capital and other jobs to be done by the maintenance department are added. When these estimates are completed, maintenance administrative and overhead costs are added and the complete prediction submitted to management.

Basis for estimation of true maintenance costs, by cost center, should be data on previous year's performance adjusted for changes in equipment involved, production throughput, cost index and labor rates.

Basis for estimation of project maintenance should be the sum of all predictable job costs plus a reasonable allowance for contingencies.

▶ **Cost Presentation for Control**—This maintenance cost presentation and the work backlog record are used together. Here is an example of how they might work.

Let us suppose that we have a rising work backlog. We look at the total current and cumulative cost of operating the entire department and find no significant variance from budget. We then look at the cumulative figures. The point of excessive expenditures will probably stick out like a sore thumb. (Sometimes excessive expenditures are still in backlog.)

When the excessive expenditures are in true maintenance, it is the responsibility of the maintenance department to take corrective action or explain "why for."

When the excessive expenditures are elsewhere, it is the responsibility of the maintenance department to call it to the attention of plant management, to request the reason and to point out that this work overload cannot be indefinitely compensated for by delayed true maintenance or backlog expansion.

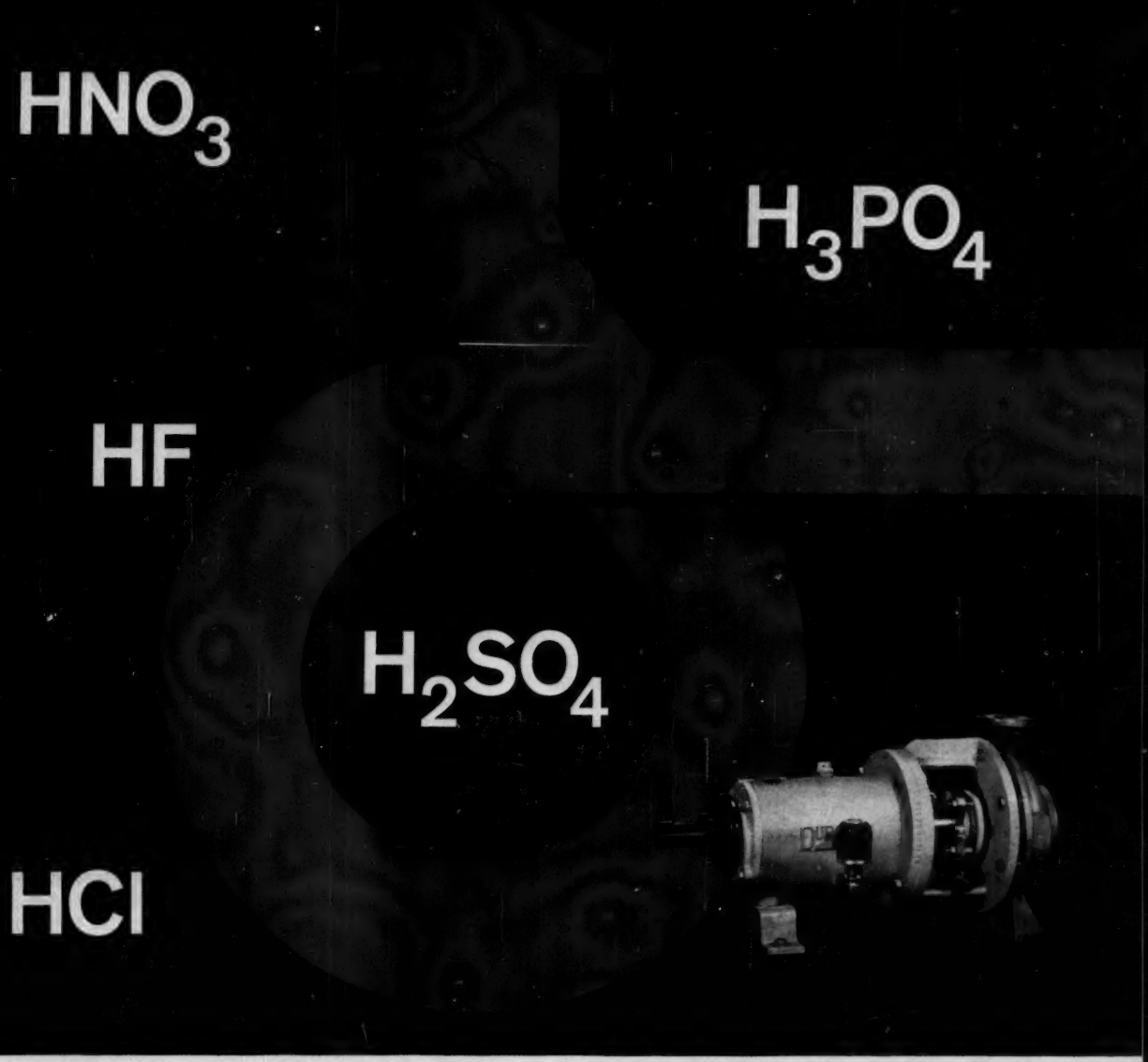
This system has few if any inherent built in variances to cry wolf when no emergency exits. Through its use, there is a much better chance of catching trends before they are out of hand.

▶ **Cumulative Plotting**—To supplement the foregoing, graphical presentation of the cumulative data may prove quite useful. Total maintenance department expenditures can be plotted, but we also recommend separate plots for each cost center.

Meet the Author

RAYMOND I. REUL is a nationally recognized expert on cost reduction techniques in a wide variety of plant functions and operations. In addition to directing FMC's work simplification and cost reduction programs, he teaches at New York University and Rutgers University. He also travels extensively while conducting seminars on industrial engineering subjects.

Mr. Reul is a graduate of Lehigh University and is the author of many papers and articles on various phases of industrial engineering.



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No. 40: LABOR FACTORS; ELECTRIC PANELS & CABINETS

E. Wayne Michel, *Member AACE, Baton Rouge, La.*

The following tabulations give labor man-hours for lighting and distribution panels and cabinets. Based on experience in Gulf and West Coast areas, units represent work of an average journeyman.

For lighting panelboards, units are total man-hr. for installation of panel and cabinet. Labor for supports, sub-feeder or conduit connections is not included. Units hold for circuit-breaker type or switch and/or fuse type. For dust-tight or explosion-proof cabinets, increase units 20%; for oil-immersed panels, increase units 30%.

For distribution panels and cabinets, units are man-hr. per terminal. Labor is not included in these factors for fastenings, supports, sub-feeders or conduit connections.

Just out, "Cost Engineering in the Process Industries" contains over 450 pages of articles and data culled from Chemical Engineering. Book should be ordered from the publisher, McGraw-Hill Book Co.

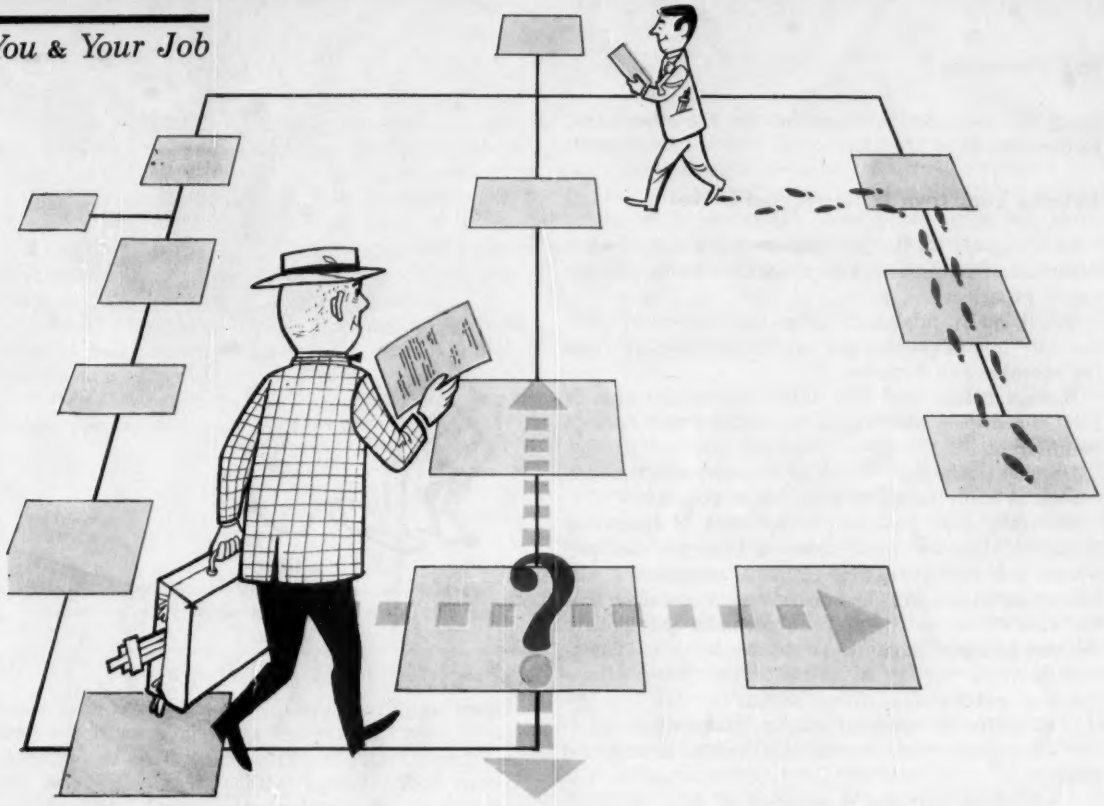
Standard Lighting Panelboards & Cabinets

Number of Two-Wire Circuits	Man-Hr. Flush	Man-Hr. Surface	Number of Two-Wire Circuits	Man-Hr. Flush	Man-Hr. Surface	Loadcenter Panels & Cabinets	Man-Hr., Flush or Surface
4	4.95	4.50	24	22.50	20.25	2	2.25
6	7.50	6.75	26	24.00	21.60	4	3.30
8	9.00	8.10	28	25.50	22.95	6	4.50
10	10.50	9.45	30	27.00	24.30	8	5.70
12	13.50	12.15	32	28.50	25.65	10	6.90
14	15.00	14.10	34	33.00	29.70	12	8.10
16	16.50	14.85	36	34.50	31.05	14	8.85
18	18.00	16.20	38	36.00	32.40	16	9.60
20	19.50	17.55	40	37.50	33.75	18	10.35
22	21.00	18.90	42	39.00	35.10	20	10.80

Note: Add labor for flush switches in trim—22 hr./100.

Distribution Panels & Cabinets

	Terminal Size, Amp.	250 Volt Under 5 Circuits Soldered Terminals	250 Volt Under 5 Circuits Solderless Terminals	250 Volt Over 5 Circuits Soldered Terminals	250 Volt Over 5 Circuits Solderless Terminals	600 Volt Under 5 Circuits Soldered Terminals	600 Volt Under 5 Circuits Solderless Terminals	600 Volt Over 5 Circuits Soldered Terminals	600 Volt Over 5 Circuits Solderless Terminals
Std.	30	0.66	0.60	0.52	0.48	0.72	0.66	0.57	0.52
Switch &	60	0.97	0.87	0.78	0.70	1.05	0.94	0.85	0.78
Fuse	100	1.60	1.45	1.29	1.15	1.80	1.62	1.42	1.29
Panels	200	2.25	2.02	1.83	1.65	2.47	2.25	2.01	1.80
	400	3.52	3.15	2.80	2.55	3.90	3.52	3.07	2.77
Safety	30	0.72	0.66	0.57	0.52	0.79	0.72	0.63	0.57
Pull-out	60	1.08	0.96	0.85	0.78	1.20	1.08	0.94	0.85
Panels	100	1.78	1.60	1.42	1.29	1.98	1.77	1.57	1.42
	200	2.47	2.25	2.01	1.80	2.77	2.47	2.20	2.02
	400	3.75	3.37	3.07	2.77	4.80	4.35	3.82	3.45
Circuit-	30	0.82	0.75	0.66	0.60	1.20	0.82	0.72	0.64
Breaker	50	1.20	1.08	0.97	0.87	1.35	1.20	1.08	0.97
Panels	100	2.02	1.83	1.62	1.45	2.25	2.02	1.80	1.62
	225	2.85	2.55	2.29	2.05	3.18	2.85	2.55	2.29
	400	4.50	4.05	3.52	3.15	4.87	4.35	3.87	3.48
	600	5.40	4.87	4.35	3.90	6.00	5.40	4.80	4.32



How to Start Out on the Right Foot

What words of wisdom do you offer to young engineers assigned to work under your direction? Here's a novel solution to the problem.

ROBERT GRAY POWELL
Monsanto Chemical Co.

Dear Bob:

Tomorrow you begin your career in chemical engineering with Monsanto. As your first supervisor, I am anxious to help you get off to a good start in the early stages of that career.

I have asked myself, "What would I have appreciated most from my first supervisor?" The answer is a frame of reference—a perspective, if you prefer—against which to evaluate my day-to-day job experience. Therefore, I've tried to provide that in some observations and suggestions that follow.

But first, you should realize that this is not something that can be digested in one sitting. In fact these guideposts can be meaningful to you only as you weave them into your job experience and your own philosophy of life.

I suggest that you read this letter once each month for the next six months. Then review it once each six months thereafter. Within five years you'll probably want to write your own version of this letter and send it to the engineers you'll be supervising then.

Anyone who supervises the work of others can compare his job to a board with many, many nails, just started, all of which must be driven in. Each nail represents a task or detail to be completed either by you or someone who works for you.

One "lick" takes care of some nails, others require many; in most cases a single lick won't do. This means that the supervisor must keep many nails going simultaneously, rotating and driving hard or easy as the situation dictates.

Secret of good supervision is this:

- Know the opportune time to put in a lick.
- Don't overlook any nail completely.

Don't Overlook Any of the Nails

To prevent overlooking any nails, I urge you to get the notebook habit. Jot down your assignments. Review them as necessary. Some jobs are quicker done than written down (one-lick nails), but not many.

Develop a system of reporting back to your supervisor. Keep him well enough informed to do his job.

Study his needs for information. On the other hand, be considerate of his time.

Develop Your Own Initiative and Drive

In five years on the job some people get one year's experience five times. You should strive to get five years' experience.

You'll make mistakes, sure, but remember that the only unpardonable "sin" is in not learning from the mistakes you do make.

Human beings get into ruts. Sometimes this is good, sometimes bad. Dare to conform and dare to be different.

Develop initiative. Think of as many ideas as you can on as many facets of your job as you can.

Naturally some restraint is required in exercising initiative. So test your ideas as best you can and where you feel there's merit take suggestions and recommendations to your supervisor. Remember that the man closest to the problem normally should have the best ideas and suggestions about solving it. Therefore, develop the art of going to your boss with a decision, not for one. Some actions:

- Require no approval and/or information.
- Are taken independently and the boss is informed later.
- Must be approved in advance.

Boundaries are important. Be sure that they are defined clearly. Then stay well within them.

There Are Three Kinds of Problems

Most problems can be attacked as one in either: organization, education or communication.

Learn to use this concept as a tool to help you develop the "climate" within which your people work. As you move up the ladder of management assignments, you'll find that developing the proper climate is (or should be) your principal objective.

Operators can explain many things. Ask for their advice. Don't be afraid to show your ignorance.

Learn while you have the chance. Each level offers opportunities that are not available even at the next one above it. Opportunities lost cannot be regained.

Learn to do things with your hands. Ask the operators to let you turn the valves. Be curious. When equipment is opened up, study it and find out what makes it tick, how it's put together.

Don't be afraid to ask the operators questions, or anyone for that matter. Have no exaggerated qualms about "showing your ignorance." New as you are there are many things you can explain to the operators right now. However, there are many more things that they can explain to you.

Learn the difference as quickly as you can. You must be both a teacher and a pupil throughout your entire chemical engineering career.

Ultimately you will realize that the most important ability you must develop is the art of handling people. It should be helpful to know this now, though it may not be possible to appreciate it fully without some experience under your belt.

You'll find that the company, too, is aware of this and offers many supervisory training and development programs designed to improve this ability.

Learn to Tolerate Mistakes

Do not be unduly critical of the mistakes of others. Do not expect others to use better methods and skills in human relations than you are capable of and willing to apply to yourself.

Usually those who demand "perfection" in the methods others use are the ones who use the least consideration when they are dealing with others.

This involves more than just on-the-job relations. Any member of the clergy or social worker can tell you that the people who demand the most of society are frequently the ones who contribute the least to it.

Sincere application of good human relations should never be equated with being soft in dealing with people. Indeed it is more effective if straightforward and firm.

Workers want to know what the boundaries are, to know as clearly and as distinctly as it is humanly possible to outline them. Then they expect to be rewarded for staying within these boundaries and to be punished for straying outside of them.

In good employer-employee relationships an indication of pleasure or displeasure is often all that is needed as a reward or a punishment.

Never underestimate the "power" that is in your hands just by virtue of the fact that your employees want to please you. They will search your face and your actions for clues as to whether they are pleasing you. Do not be afraid of showing displeasure, even to the point of getting mad, so long as you don't behave rudely or make wild statements that you'll regret later.

Help your boss sell ideas to the right person up the line. Your future depends on his.

In my opinion there is something wrong with the supervisor who never gets mad.

Fair and equal treatment may mean punishing one employee and rewarding another. It certainly doesn't mean treating everyone the same regardless of performance.

Get the Backlog Down to Zero

Any supervisor necessarily works with a backlog of things that should have been done yesterday. Remember this and develop the art of knowing which things should come first. But always be trying to work the backlog down to zero. Working hours and working load will fluctuate with conditions. No supervisor can hope to "go places" on just 40 hours/week.

Be honest with your people. Figuratively speaking, if you have to ask a man to clean up a mess, don't beat around the bush. Above all don't insult his intelligence by pretending that it's not a mess at all, but really only chocolate ice cream. Far better to face up to the fact that it's occasionally necessary to ask people to do some tasks that are unpleasant.

In hunting or athletics, "getting the jump" on your opponent is essential. Good planning is the tool a supervisor uses to get the jump on his job. Anticipate in *advance* which nail will need to be hit, how hard and when.

Sell Your Ideas to the Right Person

Learn to sell yourself and your ideas. No idea, however meritorious, will accomplish anything until sold to the right persons. When you sell, always keep foremost in your mind, "What do I have or what can I do that will help him, not me?"

Expect to make decisions. You will hear a great deal about being decisive. It is an important word in the management vocabulary and much credit is properly due the man who makes good decisions quickly.

It is also the most maligned word in the management vocabulary, for, to many, the means has become the end and the test is whether or not a decision is made quickly, not whether it is a good decision.

Good planning will help make time your ally in decision-making. I believe that no major decision should be made final until the "due" date. Time may turn up some more facts. On the other hand, if you can't get all the facts before the due date, do something anyway. The worst thing you can do is to do nothing at all. If you must make a mistake, make it with authority.

That's all for now, Bob. I hope these pointers help you. I can truthfully say that I wish someone had given me this same letter my first day on the job.

Sincerely,
BOB POWELL

Meet the Author

ROBERT GRAY POWELL, *is manufacturing superintendent at Monsanto's sulfuric acid plant in Avon, Calif. He is responsible for all phases of operation, maintenance, process improvement and staffing of this plant. He is also Monsanto's Inorganic Div. representative at Avon responsible for return on investment and for liaison with Tidewater Oil Co., which owns half of the acid facilities. Powell is a chemical engineer from Texas A&M, a member of AIChE and a registered professional engineer.*

News from

National Carbon Company

Division of Union Carbide Corporation · 270 Park Avenue, New York 17, New York

In Canada: Union Carbide Canada Limited, Toronto

National Carbon Design Engineers expand your engineering force

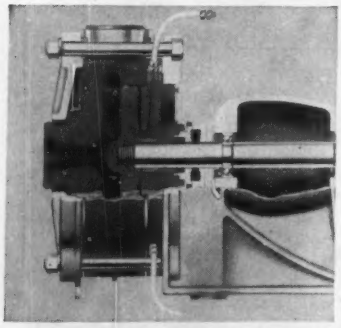
J. A. MRAZ

Design Engineer

Mr. Mraz was graduated from Fenn College in 1953 with a B. S. in Chemical Engineering. He joined National Carbon Company the same year and spent the following two years in the sales engineering department. Here he designed carbon, graphite and "Karbate" impervious graphite chemical process equipment.

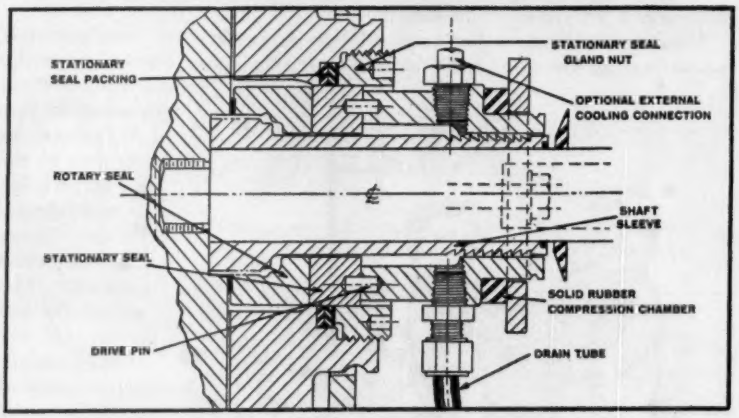
Jim's been specializing, for the past five years, in the thermal design and development of "Karbate" impervious graphite heat transfer equipment.

Seal cooling water connection modified on "Karbate" Model CA centrifugal pumps



This new seal cooling water design offers a stronger connection because it is made through the "Karbate" impervious graphite case cover. This eliminates placing stresses on the plastic water retaining shield which previously held the water connection. With the new arrangement, water flows directly on the rotary seal, thereby assuring complete cooling. Water is drained from the case seal cavity through a drain connection which is attached to the "Karbate" case cover.

REDESIGNED SEAL ARRANGEMENT ON "KARBATE" TYPE F MOTOR-MOUNTED PUMPS IMPROVES OVERALL OPERATION



NATIONAL CARBON presently is supplying the type F centrifugal pump with a new rotary seal arrangement designated as model series FBL which replaces series FAL. The redesigned seal eliminates all but one metal part and provides simple adjustment for stationary seal packing and seal setting. The adjustments can be performed while the pump is in operation. To provide protection against corrosion, the seal is designed to keep any leakage from contacting metal parts of the pump. If desired, the seal arrangement can be easily adapted for external water cooling. For additional data, write for **Catalog Section S-7253 CJ.**

"Karbate" centrifugal pumps can be belt-driven to obtain high heads and flows

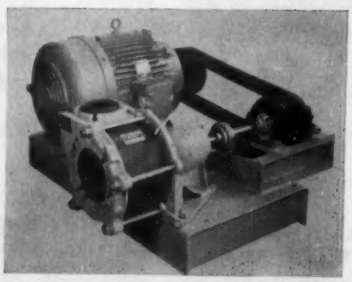


Illustration shows a belt-driven assembly of a "Karbate" type C Model 4CA-10 pump which will handle 1,000 GPM of Cl_2 saturated NaCl brine against a total dynamic head of 120′ of brine. The power source is a 60 hp, 1750 rpm motor with a V-belt arrangement which permits operation at 1920 rpm. This is accomplished by utilizing six V-belts on an 11″ pitch dia. driver sheave to a 10″ pitch dia. pump sheave.

"National","Union Carbide","N" and Shield Device and "Karbate" are registered trade-marks for products of

NATIONAL CARBON COMPANY

UNION CARBIDE

Chart for Compression and Expansion Temperatures

Speedily-constructed chart gives outlet temperature for turbines or compressors and, hence, allows ready calculation of the shaft horsepower developed or required.

★ **Winner of Midsummer Contest by**
CARL A. KLEPPE
*Prod. Engineer, Cleaver-Brooks Special Products Inc., Waukesha, Wis.**

The above chart provides a simple method of calculating temperature change during an adiabatic expansion or compression. The result can then be used to calculate the power required by a compressor or produced by a turbine.

▶ **Construction**—Using log paper, number the abscissa and ordinates as shown. The right-hand ordinate is divided in ten equal parts and straight lines through zero complete the plot. Number the lines as shown.

▶ **Derivation of Chart**—The mathematical development of the plot is as follows:

For compression:

$$(\Delta T/T_1) + 1 = (P_2/P_1)^{(k-1)/k}$$

Let

$$(\Delta T/T_1) + 1 = y$$

then

$$y = (P_2/P_1)^{(k-1)/k}$$

Taking logs

$$\log y = \left(\frac{k-1}{k}\right) \log \frac{P_2}{P_1}$$

When plotted on log-log paper, the above equation is a straight line with pressure ratio as abscissa and $\Delta T/T_1$ as ordinate. Slope of the lines gives $(k-1)/k$. For the case of expansion, a similar result may be derived from the equation:

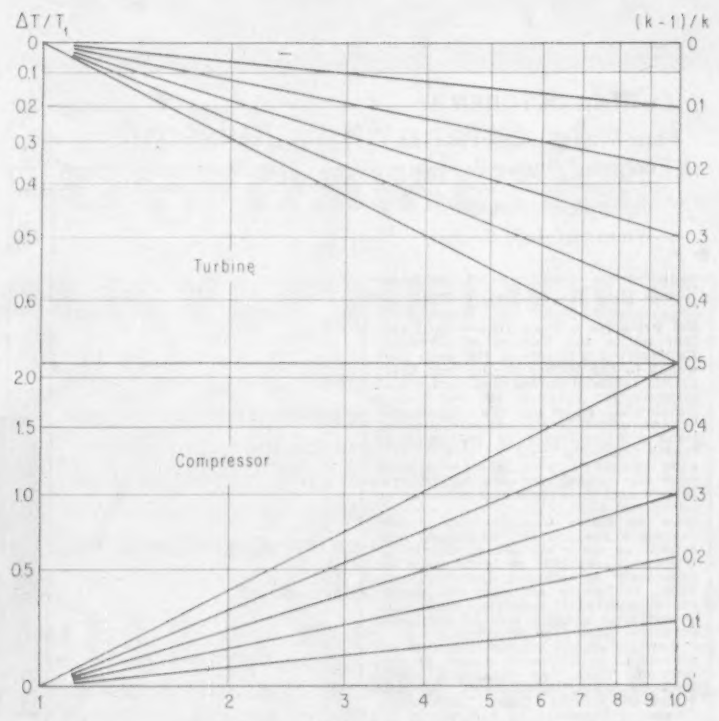
$$\Delta T/T_1 = \frac{(P_1/P_2)^{(k-1)/k} - 1}{(P_1/P_2)^{(k-1)/k}}$$

▶ **Example I**—95,200 lb./hr. of nitrogen is available at 1,050 F. and 27.6 psig. How much power could be recovered by expanding this gas to atmosphere through a turbine? Assume a five-stage turbine with an internal efficiency n_i of 84% and a mechanical efficiency n_m of 99% is available.

Estimating that the average temperature during expansion will be about 900 F., gives us 0.27 for c_p and 1.36 for k. (L. S. Marks, "Mechanical Engineers' Handbook,"

Nomenclature

c_p	Specific heat at constant pressure, average.
c_v	Specific heat at constant volume, average.
k	Ratio of specific heats, c_p/c_v.
n_i	Isentropic or adiabatic efficiency of turbine or compressor.
n_m	Mechanical efficiency.
P	Pressure, psia.
T_1	Inlet temperature, °R.
ΔT	Isentropic temperature change.
W	Gas flow, lb./hr.



* Mr. Kleppe developed this method while with Allis-Chalmers Manufacturing Co., Milwaukee, Wis.

Fourth Edition, p. 301, McGraw-Hill, 1941.)

$P_1/P_1 = (27.6 + 14.7)/14.7 = 2.875$
$(k - 1)/k = 0.36/1.36 = 0.265$
From the chart,

$$\Delta T/T_1 = 0.244$$

Using this temperature ratio, we can calculate the shaft horsepower from:

$$SHP = (\Delta T/T_1)\left(\frac{Wc_p\, T_1\, n_i\, n_m}{2{,}545}\right)$$

This gives a shaft horsepower of 3,100. Further, the actual temperature drop is (0.84) (0.244) (1050 + 460) = 309 F., and the turbine exhaust temperature is 1,050 − 309 = 741 F.

▶**Example II**—A compressor is to be used for a simple cycle-gas turbine power unit. Air flow through the compressor will be 207,200 lb./hr. If the discharge pressure is 35.3 psig., what driver horsepower will be required? Ambient conditions are 80 F. and 14.7 psia. Assume an internal efficiency of 81% and a mechanical efficiency of 99%.

An estimated average temperature of 200 F. during compression gives 0.241 for c_p and 1.397 for k.

$P_1/P_2 = (35.3 + 14.7)/14.7 = 3.40$
$(k - 1)/k = 0.397/1.397 = 0.285$
From the chart,

$$T/T_1 = 0.42$$

Now, the shaft horsepower can be calculated from:

$$SHP = (\Delta T/T_1)\left(\frac{Wc_p\, T_1}{2{,}545\, n_i\, n_m}\right)$$

This gives a shaft horsepower of 5,550 and a discharge temperature of 360 F.

CORROSIVE-ACIDS HEATER

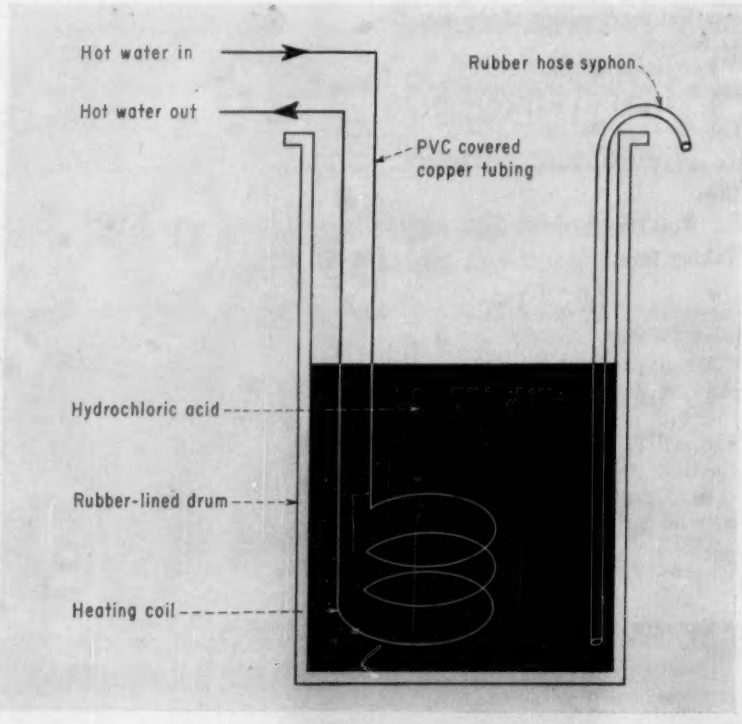
ROBERT T. GAUDLITZ
A. E. Staley Manufacturing Co., Decatur, Ill.

Often in plant or pilot plant work, it is necessary to heat a small quantity of corrosive material without contamination.

We encountered this problem in a pilot plant operation when we had to heat 20 Be hydrochloric acid to a temperature of 110 F. The acid could not be diluted or contaminated in any way.

A simply effected solution is shown in the accompanying sketch. We left the acid in the rubber-lined drum in which it was delivered. From the instrument supply storeroom, we got a length of ¾-in. copper tubing covered with polyvinyl chloride and coiled it in the drum as shown. For heating medium, we circulated hot water at 140 F. from the building supply.

Although we found that the PVC covering on the coil reduced the heat transfer coefficient, the apparatus more than adequately did the job. Another heating medium, such as low pressure steam, could have been used instead.



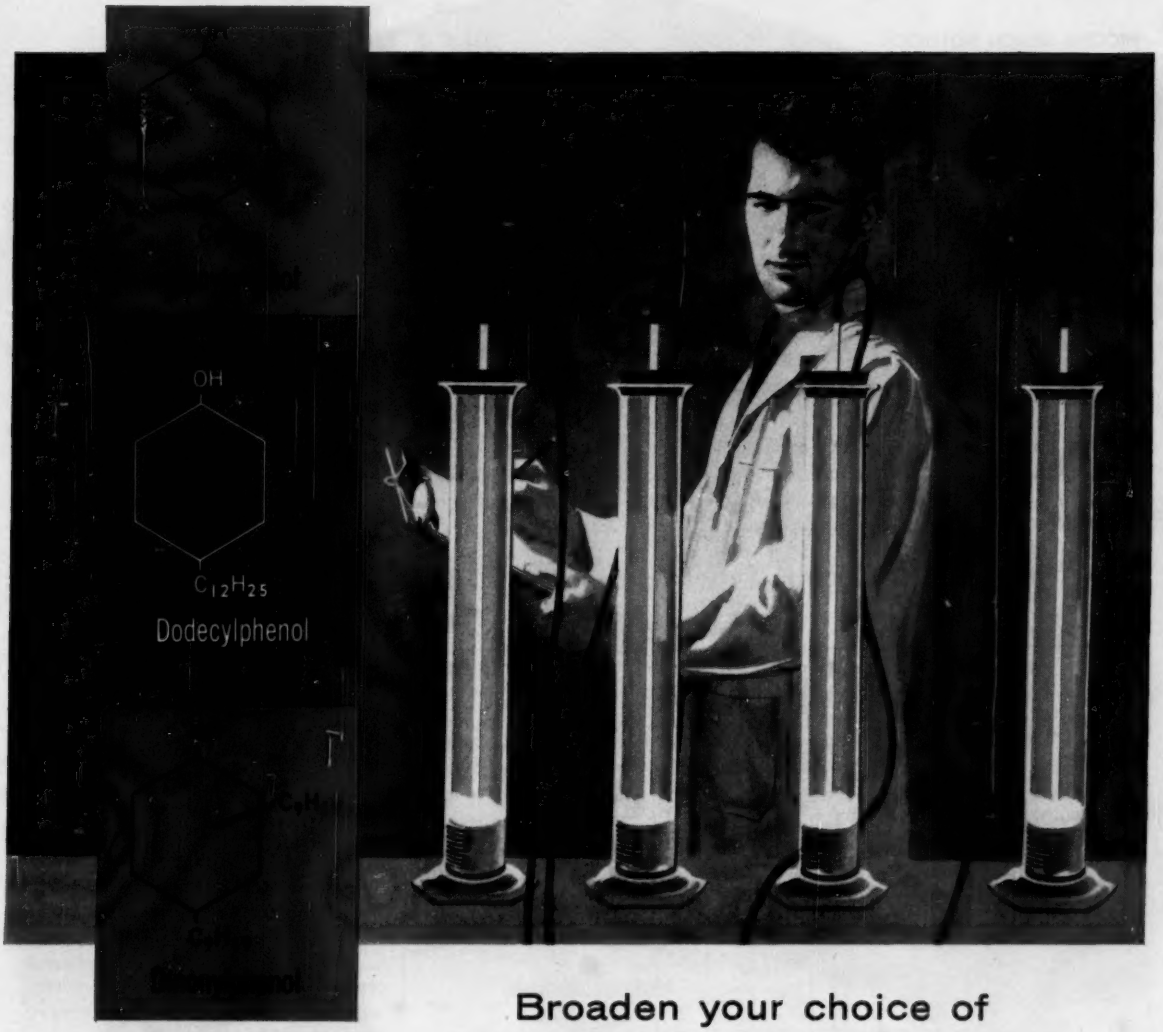
COMING OCTOBER 3:

Four-Way Valves Provide Foolproof Piping System

By Dick E. Milholland
Winner of July Contest

★ How Readers Can Win

$50 Prize for a Good Idea—Until further notice the Editors of *Chemical Engineering* will award $50 each four weeks to the author of the best short article received during that period and accepted for Plant or Process Design Notebooks. Each period's winner will be announced in the second following issue and published in the third or fourth following issue.
$100 Annual Prize—At the end of each year the period winners will be rejudged and the year's best awarded an additional $100 prize.
How to Enter Contest—Any reader (except a McGraw-Hill employee) may submit as many contest entries as he wishes. Acceptable material must be previously unpublished and should be short, preferably not over 500 words, but illustrated if possible. Acceptable nonwinning articles will be published at space rates ($10 minimum).
Articles should interest chemical engineers in development, design or production. They may deal with useful methods, data, calculations. Address Plant & Process Design Notebooks, *Chemical Engineering*, 330 W. 42 St., New York 36, N. Y.



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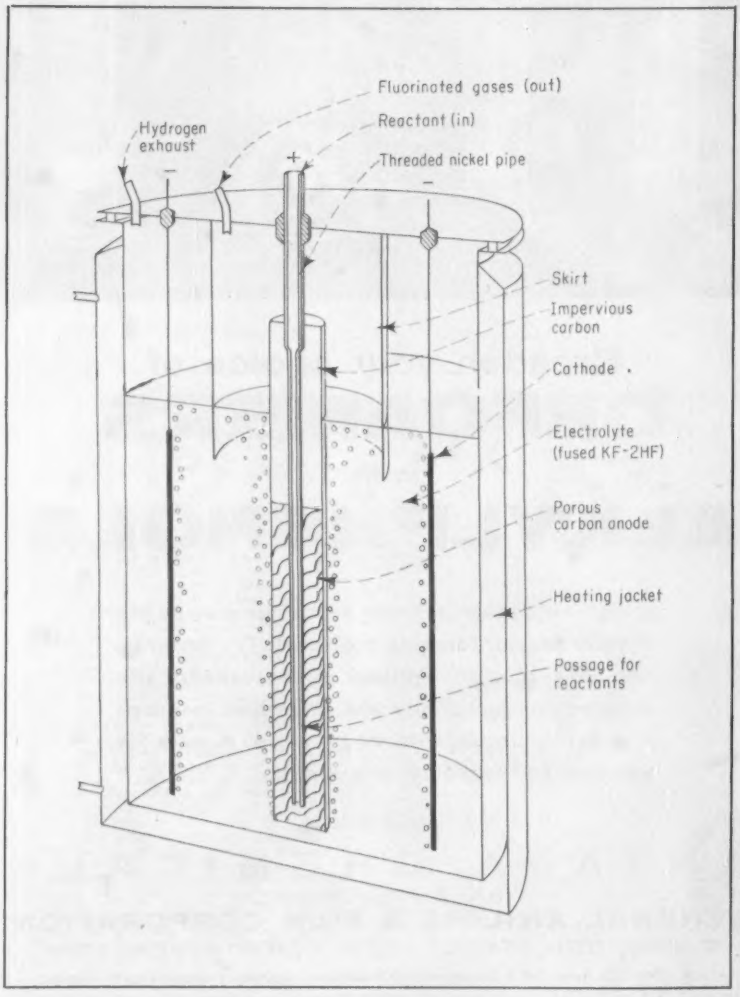
ELECTROCHEMICAL FLUORINATOR USES POROUS CARBON ANODE

DONALD R. ALLEN
Director of Research, Alchem, Orlando, Fla.

Some time ago, I designed and operated an electrochemical fluorination cell equipped with a porous carbon anode. This modification of the regular medium-temperature elementary fluorine cell permits direct fluorination of vapors and liquids within the cell body itself without the necessity of producing and handling gaseous fluorine outside the cell. Such diverse substances as hydrogen sulfide, sulfur dioxide, ammonia and water can be fluorinated in the cell by pumping the reactant into the porous carbon anode while the cell is in operation.

▶ **Operation** — The cell's electrolyte, KF.2HF, is kept molten during operation by a hot water jacket surrounding the cell body. Temperature of operation is about 100 C. The reactant to be fluorinated is metered directly, or with an inert diluent such as nitrogen, into the anode through the pipe connection at the top of the cell. The fluorinated products of reaction gather at the top of the anode compartment and leave the cell through the anode exhaust line to some suitable receiver.



The illustration is a schematic cross section of the cell, showing detail of the porous carbon anode. The skirt is used to confine the products of reaction to the anode exhaust compartment of the fluorination cell.

By balancing the rate of generation of fluorine with the rate of admission of the reactant, little or no fluorine leaves the cell with the product. Hydrogen gas is generated at the operating cathode and leaves the cell at the cathode exhaust opening.

The cell operates at voltages ranging from 9 to 11 volts, direct current, like an ordinary elementary fluorine cell.

With this porous anode device, we have produced sulfur hexafluoride (SF_6) from H_2S, sulfuryl fluoride (SO_2F_2) from SO_2, nitrogen trifluoride (NF_3) from ammonia, oxygen difluoride (OF_2) from water and several fluoro-organics from acetone and many other suitable reactants.

The cell is capable of continuous operation and the cell products can be changed at will by changing the reactant being injected into the porous anode.

A single engineer or chemist can safely operate the device without assistance, making it particularly useful for smaller laboratories—or laboratories wishing to fluorinate a wide variety of vapors and liquids without the need or dangers of handling such a hazardous material as elementary fluorine.

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All kinds are available—gate, globe, angle, check, "Y", relief, flush bottom tank valves, etc. They are scientifically designed and ruggedly built for top performance when used in the service for which they are recommended. Either consult your nearby Powell Valve distributor—or write to us for illustrated literature.

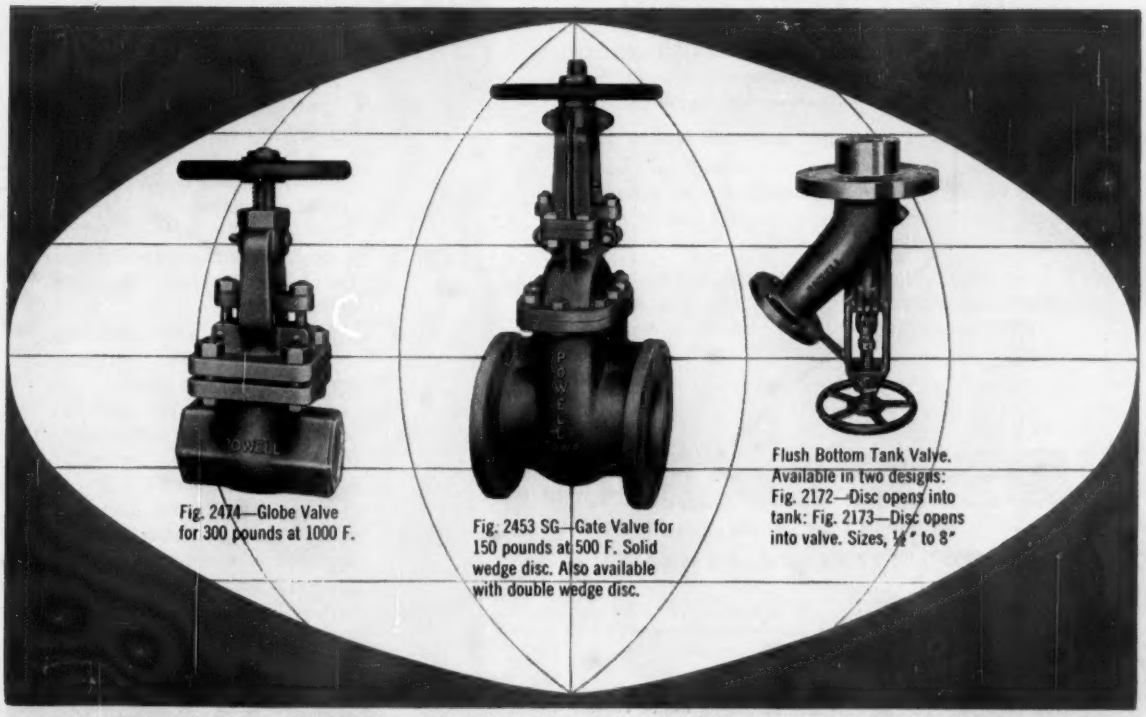

Fig. 2474—Globe Valve for 300 pounds at 1000 F.

Fig. 2453 SG—Gate Valve for 150 pounds at 500 F. Solid wedge disc. Also available with double wedge disc.

Flush Bottom Tank Valve. Available in two designs: Fig. 2172—Disc opens into tank: Fig. 2173—Disc opens into valve. Sizes, ½" to 8"

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Anodic Protection: How Good Is It?

Even considering that anodic protection has severe limitations, it is a powerful new tool for controlling process corrosion with impressed currents.

Cathodic protection techniques are well known and widely applied to a number of practical corrosion problems. But it is not so well known that corrosion can also be prevented in certain cases by anodic protection, using a platinum-electrode impressed-current system.

There has been some activity in this country on the application of anodic protection to process equipment, mainly by Continental Oil (*Chem. Eng.*, Nov. 30, 1959, p. 112).

In fact, Conoco has recently licensed Minneapolis-Honeywell, Minneapolis, Minn., to manufacture and market Conoco's Anotrol system, which involves electronic circuitry.

The system will be offered initially for corrosion control in the storage and processing of sulfuric and other acids, as well as caustics. Equipment that can be protected includes storage tanks, tank cars, trucks, barges and process vessels.

But except for Conoco, there is very little work going on here (or in Europe) on the application of anodic protection to plant processes.

► **Missing Bet**—C. Edeleanu, in a recent article in the *Platinum Metals Review*, claims that many engineers are missing a good bet by ignoring anodic protection. From a corrosion standpoint, this technique is to a chemical vessel what a temperature controller is to a furnace.

The reluctance to try it, Edeleanu believes, is due to an inadequate understanding of how the method works and a feeling that it is a laboratory curiosity. Actually, there is nothing more strange in protection by anodic current than there is in protection by oxidizing agents, such as chromates.

► **Immunity or Passivity**—Ignoring the use of plastics, glass or coatings, there are two basic methods of practical corrosion control.

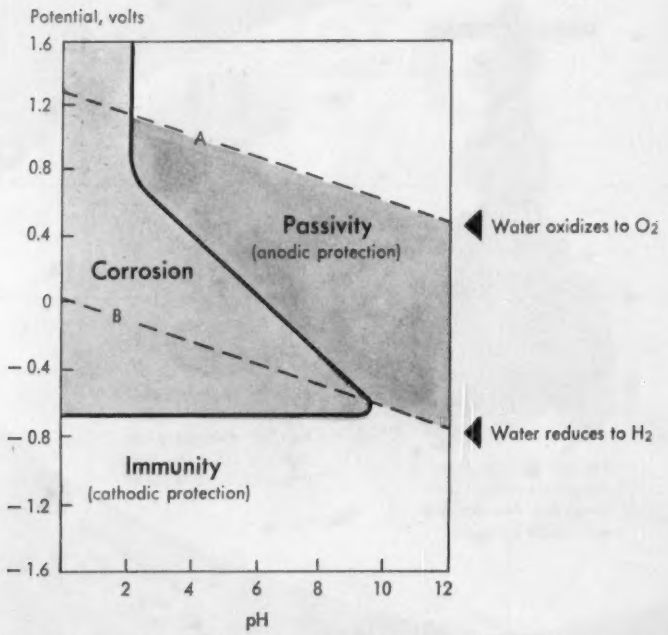
One is to reduce the driving force available for corrosion* to a minimum, the other is to ensure that the corrosion product itself stifles the reaction by forming a protective film. The first is protection by immunity, the second protection by passivity.

In practice, immunity is achieved by:

- Using a suitable noble metal.
- Removing unnecessary oxidizing agents such as air.
- Adding a cathodic inhibitor (lessening the effectiveness of the oxidizing agents).
- Applying cathodic protection to counteract the corrosion current (impressed current or sacrificial anodes).

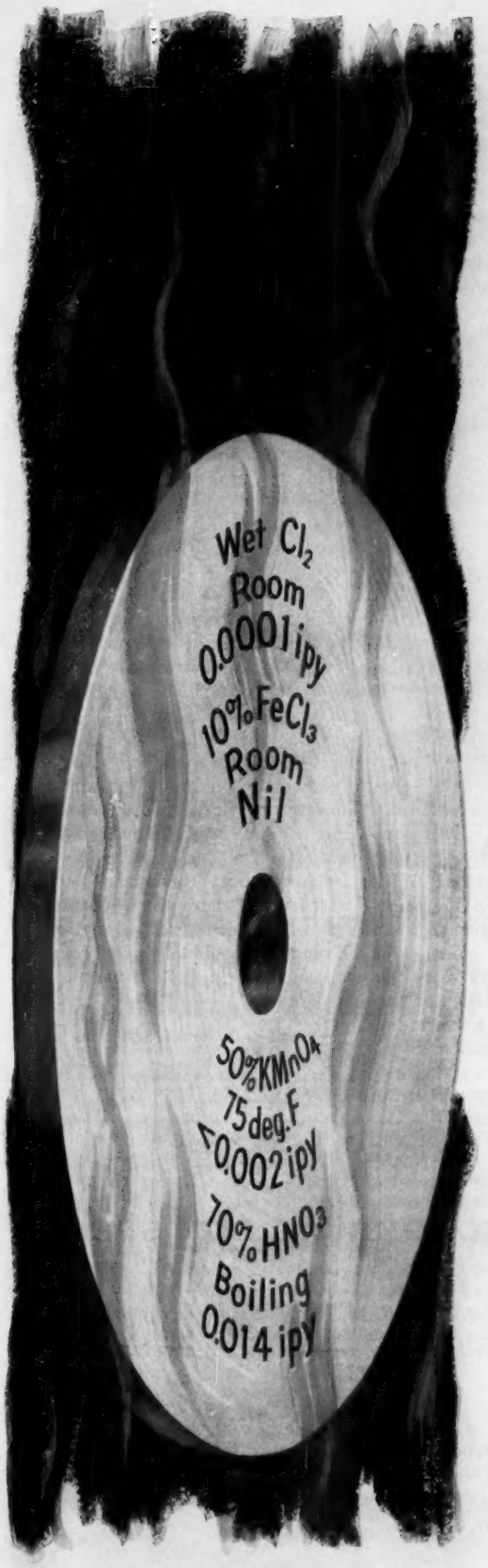
In a chemical plant, each of these techniques has a place, but each has definite disadvantages. Noble metals are expensive. Also, if the solution is highly oxidizing, the other methods can't be used—this is one reason why cathodic protection has been limited mainly to use against soil corrosion or to protect equipment against water attack. Cathodic protection is not very effective on complicated equipment.

On the other hand, passivity



Iron becomes "passive" in acid solutions under certain voltages.

*This assumes that corrosion involves a flow of electricity between certain areas on a metal surface through a conducting solution.



Corrosion from Oxidizing Chemicals?

...Test **HAYNES** Alloys

Even in such violently corrosive oxidizing agents as ferric chloride—at concentrations boosted to 40 per cent and temperatures as high as 140 deg. F.—HASTELLOY alloy C figuratively snaps its fingers. At room temperature, its reaction is nil!

Alloy C and other HAYNES alloys resist most of the common oxidizing chemicals. Alloy C also resists strongly oxidizing salts such as cupric chloride, ferric and cupric sulphate, and chromates and nitrates in sulphuric and hydrochloric acids.

Send for test samples

If oxidizing chemicals are causing excessive damage to equipment in your plant, you'll almost surely find the remedy among HAYNES alloys. We have been developing and producing corrosion-resistant alloys for thirty years.

Send us a letter outlining the corrosive conditions. This will help us select the proper HAYNES alloy samples to test for yourself. Be sure to ask for a booklet on HASTELLOY alloys. Address us at 270 Park Avenue, New York 17, N. Y.

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of metallics comes about when:

• Using a metal having an oxide (or other similar corrosion product) that is virtually insoluble in the medium.

• Ensuring that sufficient oxidizing agent is always present for the oxide to be formed.

• Applying anodic polarization to maintain the oxide in constant repair.

▶ **Best for Fe Alloys**—Most experts agree that anodic protection will prove most useful with iron-based alloys in acid solutions. The diagram on p. 218 shows the conditions for iron immunity and passivity. It's evident that there is a considerable range of potentials over which neither of these conditions are reached and which cause rapid corrosion.

Lines A and B refer to the upper and lower limits of water stability. Above A, water is oxidized to oxygen, below B, it is reduced to hydrogen.

If iron is placed in a strong acid solution, it can theoretically be protected by lowering its potential to the immunity region. But, since water is not stable at such potentials, continuous and rapid hydrogen evolution will occur.

Raising the potential by anodic polarization to the passive range seems to be a much more promising way of avoiding corrosion. Once the potential is high enough, the corrosion rate falls to negligible values. Actually, this is all anodic protection does: it keeps the potential of the metal sufficiently high, by an impressed current, to maintain a stable oxide film. It's particularly valuable where a metal's natural passivity breaks down due to unfavorable conditions or where, in a certain environment, the metal never reaches a passive state on its own.

▶ **Precise Control**—There is usually an upper and lower limit to the range of potentials that give satisfactory results. This means the instrument needed for anodic protection is a potentiostat. Such an instrument measures the potential of a vessel (anode) against a reference electrode, and maintains it at the desired value by passing a polarizing current from a platinum electrode through the corrosive liquid to the vessel.

Numerous potentiostat circuits, capable of accurate potential control but with low current outputs, are available for laboratory use. For industrial use, instruments capable of producing several hundred amperes are needed. (Current density could be around 0.0043 amp./sq. ft. to maintain passivity.)

Solutions processed in chemical plants differ so greatly that each case has to be handled on a laboratory scale before anodic protection can be safely applied in the plant.

▶ **Severe Limitations**—Far from offering a complete answer to all corrosion problems, anodic protection involves a number of definite limitations and dangers. At potentials just below those at which passivity takes over, the corrosion rate is very high. If a vessel were to go active, the protective device would have to supply a very large current in order to re-establish passivity—a current equivalent to the highest possible corrosion rate. This is one reason why the method has not found much support until now. Serious as this situation is, it has been, perhaps, overstated. With suitable instrumentation, it's possible to overcome this difficulty.

Besides this limitation, the method can't be applied to metals having an inadequate range of passivity. And, with any given metal, passivity will not be stable in all solutions.

The method also depends on an electrolytic current arriving at the metal through the corrosive solution, so it is inapplicable above the wash line of a vessel. This same situation rules out organic, nonconducting solutions. Anodic protection will not work in halogen-containing liquids or reducing environments. And there is a spark danger which can't be ignored.

▶ **Powerful Tool**—Without doubt, these are serious limitations. But where it can be used, anodic protection should be a powerful tool. In many chemical plants, expensive grades of material are used to provide a large amount of safety against corrosion. There is no means, generally, of telling how near equipment is to losing passivity.

This sort of situation permits two distinct uses of anodic protection. First, it can be used as a safety device, perhaps allowing alloy materials to be used to their limit.

Or a plant could be designed with "inferior" materials that depended for survival entirely on anodic protection. Of course, protective equipment for the second situation would be expensive (operating costs would be low), but economics could be attractive if there was a substantial saving on construction materials. Even so, it would take great courage on someone's part to construct such a plant.

• Based on an article appearing in the current issue of *Platinum Metals Review* (a quarterly publication available from J. Bishop & Co., Malvern, Pa.) by C. Edeleanu, Tube Investments Research Laboratories, Cambridge, England.

NEW, STRONGER CARBON STEEL

Recently developed steel yields lighter, stronger structures; will displace "standard" steels.

Average savings of 4 to 6% in the weight of steel structures are promised by a new and higher-yield-point structural carbon steel now available, according to U. S. Steel.

The new steel conforms to specification A36-60T for rolled structural steel recently approved by the American Society for Testing Materials.

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should last at least 7 times longer

Huge, 100,000 gallon acid-storage tanks are a necessity with Kaiser Aluminum & Chemical Corporation . . . and *were* a *problem.* The redwood tanks previously used for storage of incoming hydrofluosilicic acid deteriorated rapidly, sprang costly-to-repair leaks, lasted for only 2½ years.

New tanks are now being erected, protected with Permobond, the rubber lining that is unaffected by a wide variety of highly corrosive "problem" chemicals. While no performance figures are yet available, naturally, the experience of other chemical manufacturers, processors and users has led Mr. J. A. Watson, Superintendent of the Kaiser Aluminum plant in Mulberry, Florida, to estimate a minimum life for the new Permobond®-protected tanks of at least 15 to 20 years. It is quite possible, in fact, that the acid will serve to *protect* the Permobond lining from eventual weakening from *other, outside* causes!

Used by Kaiser Aluminum and a wide variety of progressive companies for its demonstrated superiority over other lining materials, Permobond can be applied to existing as well as new equipment. Your local Permobond Applicator will be glad to provide you with Permobond protection service . . . select the compound, prepare the surface, apply the rubber and vulcanize the entire lining. *Get in touch with "U.S." at address below for Authorized Permobond Service in your locality.*

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Because A36 has a higher minimum yield point than present standard carbon structural steels, USS believes it will become the dominant steel used in structural applications.

Before adoption of the new A36, two other specifications for structural carbon steel were long considered the only standards in the heavy construction field.

One, ASTM A7, has for many years been generally used for bridges, buildings and other structural applications where load-bearing members are bolted or riveted. Its minimum yield point (where a load applied in tension will cause a permanent deformation of the steel) is 33,000 psi.

The other well-known carbon steel, ASTM A373, is used primarily in welded construction. Its minimum yield point is 32,000 psi.

Compared with A7 and A373 steels, the new A36 structural steel has a minimum yield point of 36,000 psi. Matched against A7 steel on an equal weight basis, A36 will withstand about 10% greater load in tension before it reaches its yield point. On the same equal-weight basis, A36 steel has about a 12% yield point advantage over the weldable A373 grade. Moreover, A36 compares favorably with A373 on weldability.

As an example of how this extra yield-point strength can cut the weight of structures built with A36 steel, USS compares it with the older A7 steel in a typical I-beam bridge:

This bridge, a familiar highway-overpass type used to carry a 28-ft.-wide roadway, has a 70 ft. span. It uses five 36-in.-wide flange beams to support the roadway plus the load of passenger car and truck traffic. Total weight of the five beams in the bridge structure is 86,670 lb. designed in A7 steel. Total weight of these beams needed for the bridge would be 81,365 lb. if designed in the new A36 steel. Over-all saving in the weight of the wide flange beams would be 5,305 lb., or 6.1%.

For bridge spans of 20 to 70 ft., average structural steel weight savings with the new A36 grade will be about 6%. For buildings and other general structural applications, estimated average weight savings would be about 5%.

Prices for A36 steel are 0.05¢/lb. higher than A7 for all structural shapes and for plates up to ¾-in. thick, which represent the bulk of steel used in construction. The A36 price difference over A7 is greater for plates and bars over ¾-in., because of additional chemical analysis needed.

For bars up to ¾-in thick, the price is the same as A7. All in all, the cost-to-strength ratio of the new steel is substantially better than for existing carbon structural steel specifications, and cost savings should result for most fabricated and erected structures.

Exotic metals become plentiful in rod and tube forms

The 700-ton extrusion press (above) *is capable of turning out various sizes of titanium and zirconium rod and tube like so much spaghetti. It will be used in extruding these "special" metals at a fabricating plant that Calumet & Hecla will open soon at Inkster, Mich.*

But you can now also buy pure beryllium tubing—a material considered very "exotic" not so long ago. Superior Tube Co., Norristown, Pa., offers such tubing in sizes from 0.250 to 2.000-in. O.D. as extruded, also makes a close-tolerance-inside-diameter tube for nuclear fuel cladding. Experimentally, 5-ft. lengths have been produced; usual lengths are about 13 in. for the close-tolerance material.

Beryllium has good oxidation resistance up to 1,500 F. It has a low neutron absorption cross section, is light weight (about half that of aluminum) with the strength of low-carbon steel, and high thermal conductivity.

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Recent price reductions are the reason. They have been made possible, in many of the popular pipe sizes, by advanced technology, production improvements, and ever-increasing sales volume.

It is now possible to pipe your entire process in corrosion-impervious Fluoroflex®-T, at prices comparable, on an installed basis, with conventional piping material of far less corrosion resistance, particularly at elevated temperatures.

Case histories of economies resulting from Fluoroflex-T are being increasingly reported, citing ease and speed of installation with prefabricated lengths, lower checkout time, decreased maintenance, long equipment life, and elimination of process headaches and downtime. One plant equipped with Fluoroflex-T, in fact, reported savings of $60,000 per month in costs of maintenance, downtime, and product loss.

Why not investigate what a Fluoroflex-TS piping installation can mean to your company, in installed costs, overall economy, and long process life? Write for complete information today!

Complete corrosion protection: Fluoroflex-T, the proprietary Teflon® product manufactured and fabricated solely by Resistoflex, is completely resistant to any chemical (except high-temperature fluorine and the molten alkali metals) up to 500° F.! It combines optimum strength and non-porosity.

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- Complete family of piping components available.
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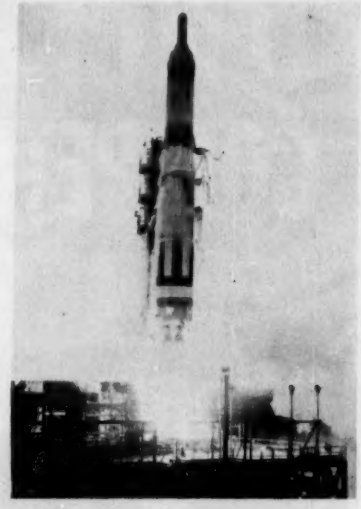
CPI BRIEFS . . .

(Continued from p. 102)

plant for processing barite (used in manufacture of drilling muds for the oil industry) at Houston. It is to be in operation by mid-November, will treat domestic barite from Missouri as well as imported barite from Mexico, Peru and the Mediterranean area.



Olin Mathieson Chemical Corp. has been awarded a three-year, $25-million contract by the Air Force, to supply hydrazine for fueling Titan-II ICBMs such as the one above. Titan-IIs are powered by a mixture of anhydrous hydrazine and unsymmetrical dimethylhydrazine; Oline Mathieson will supply the former variety. Company will make the hydrazine at a plant now under construction at Saltville, Va. Facility will cost over $14 million, is scheduled to start operating on Mar. 1, 1961.

British American Oil Co. Ltd. is operating a new alkylation unit at its Clarkson refinery, near Toronto, using hydrofluoric acid as catalyst. The $3-million facility includes a feed preparation system, two fractionating columns, acid contactors and a 154-ft. iso-stripper tower. Unit is rated at 3,000 bbl./day.

American Cyanamid Co. will double its production of wet-process phos-

phoric acid through a multimillion-dollar expansion at its Brewster, Fla., plant. Expanded facility will be able to make about 400,000 tons of 54% phosphoric acid annually, will also increase the company's output of triple superphosphate.

Crown Zellerbach Corp. will build a multimillion-dollar pulp mill near Kremmling, Colo., to produce newsprint for Rocky Mountain newspapers. Construction is expected to take two or three years.

Shell Oil Co. has placed a new 30,000-bbl./day hydrotreater on stream at its Houston Refinery. Unit desulfurizes distillate fuels by Shell's trickle-flow process, improving quality of the company's furnace-oil and diesel-fuel products.

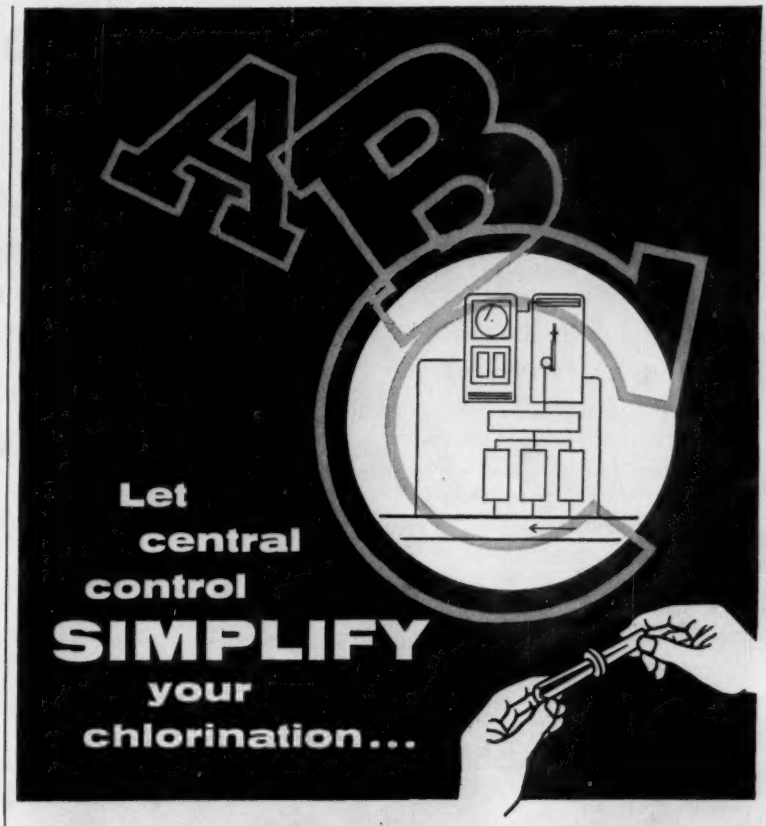
Firestone Plastics Co., division of The Firestone Tire & Rubber Co., is substantially expanding its polyvinyl chloride resins plant at Pottstown, Pa. The expansion, being handled by Catalytic Construction Co., is expected to be completed by early next year.

Mobay Products Co., subsidiary of Mobay Chemical Co., announces that it has begun commercial-scale production of polycarbonate resin at its plant in New Martinsville, W. Va.

St. Regis Paper Co. will build a $3-million technical center at Clarkston, N. Y., for research in paper, plastics, packaging and forest products.

Union Carbide Corp. announces that it will build a marine terminal for plastics resins at Perth Amboy, N. J. Union Carbide Plastics Co. will serve its Eastern customers from the new facility, which is scheduled for completion early in 1961.

C-E-I-R, Inc., an independent research and computer services firm, has started operating a high-speed IBM 7090 electronic computer at its Arlington Research Center,



W&T COMPOUND-LOOP CONTROL

By residual analysis and information feedback, Wallace & Tiernan Compound-loop Control adjusts chlorinator feed rates to changing water flows and chlorine demands. You can add W&T Remote Residual Recording and Controlling Components throughout your water system and centralize control at any desired location. You select the desired residual on a central panel and the Compound-loop System maintains that residual faithfully.

Remote recording by W&T gives you duplicate residual records and minute-to-minute information where it helps guide operation. Remote controlling by W&T lets you adjust a chlorinator miles away. And W&T Remote Components adapt to almost any system, any type of control.

With remote residual recording and controlling by Wallace & Tiernan you centralize control...save time and operating expense...extend the advantages of the Compound-loop method.

For more information, write Dept. S-142.39

WALLACE & TIERNAN INCORPORATED
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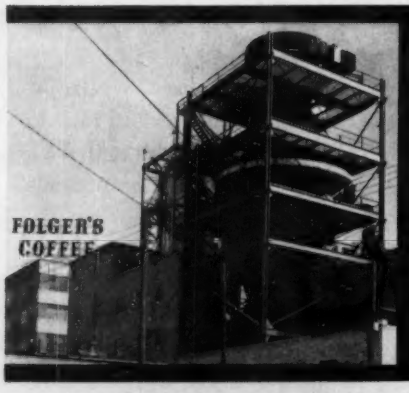
the DYNAMIC SWENSON APPROACH

...provides a unique service

To assure desired product quality, many firms in the process industries have taken advantage of the Dynamic Swenson Approach. It goes beyond ordinary consulting services because it accepts the responsibility for performance. Years of unparalleled application-engineering are focused on *your* objective. Unique custom-manufacturing carries through to experimental stages and beyond. Production is *proved* by pre-installation testing. Cost estimates are accurate. The finished product is exactly the way you want it.

When you seek a better way to dry or evaporate, benefit through the Dynamic Swenson Approach.

for The Folger Coffee Company the result was a delicious cup of instant coffee.



Write for performance report Bulletin SW-402 that tells how the Dynamic Swenson Approach was used so successfully in attaining Folger's objective . . . suggests how you, too, can benefit.

Three Swenson dryers were designed and produced in cooperation with Folger engineers. The latest installation is among the world's largest. From original consultation, through pre-testing to full scale production, the Dynamic Swenson Approach assured Folger of time and dollar savings . . . and a resulting better product.

Swenson Evaporator Company, 15669 Lathrop Avenue, Harvey, Illinois. In Canada: Whiting Corporation (Canada) Ltd., 350 Alexander Street, Welland, Ontario, Canada.

PROVED ENGINEERING FOR THE PROCESS INDUSTRIES SINCE 1889

SWENSON

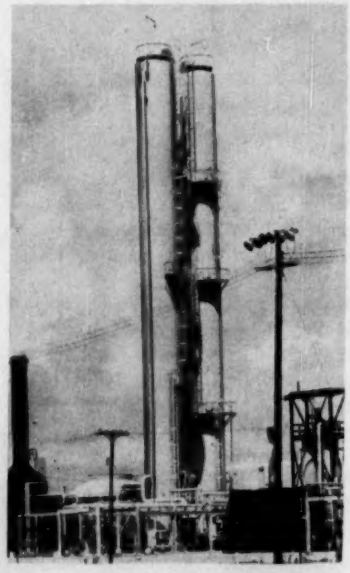
WHITING—MANUFACTURERS OF CRANES; TRAMBEAM® HANDLING SYSTEMS; PRESSUREGRIP; TRACKMOBILES;® FOUNDRY, AND RAILROAD EQUIPMENT

A Division of WHITING Corporation

CPI BRIEFS . . .

Arlington, Va. The company's new 7090 system is the first commercial installation available to both private and government users on an hourly or job basis; previous 7090 systems have been used exclusively for defense purposes. The 7090 performs computations six times faster than its predecessor, the IBM 709.

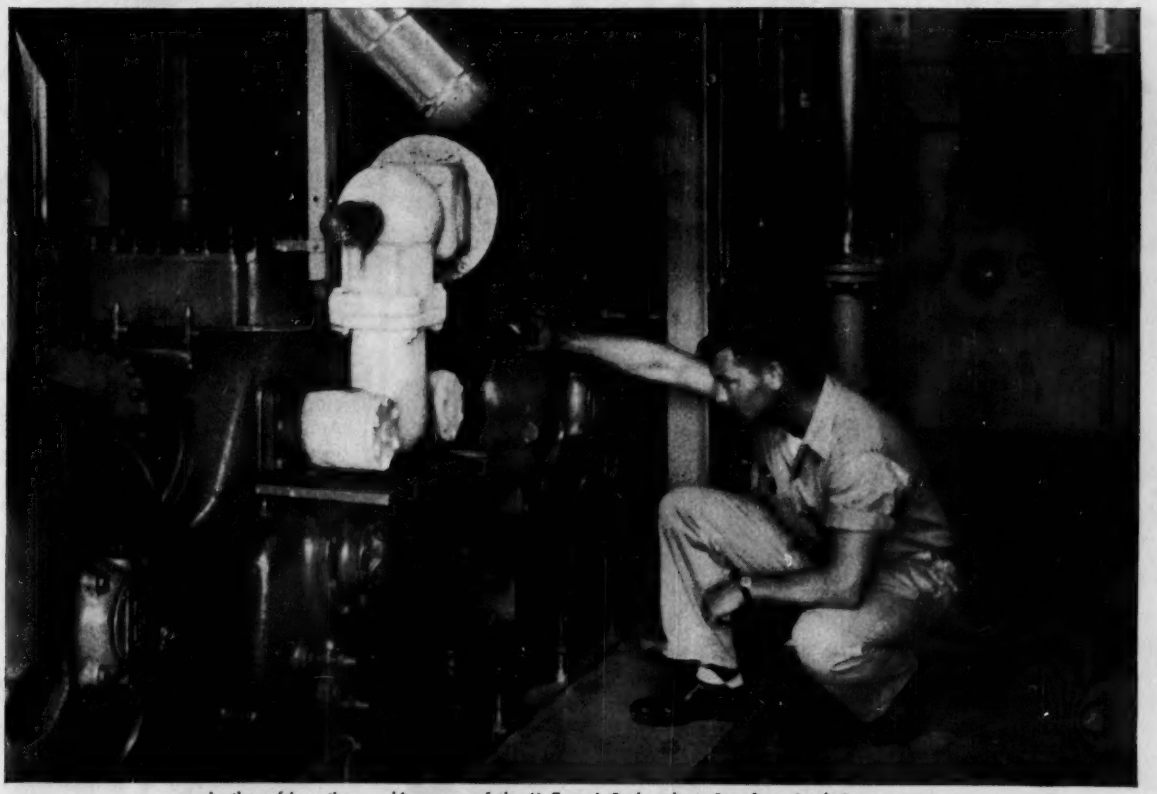
Nalco Chemical Co. announces a $1-million program for purchase of land, conversion and modernization of buildings in Chicago's Clearing Industrial District. Program involves three parcels of land, totalling about ten acres and including four buildings. The firm is acquiring the properties because it expects to expand its operations.



Delhi-Taylor Oil Corp.'s new orthoxylene plant at the firm's Corpus Christi, Tex., refinery went on stream this summer. Highlight of the unit is the pair of 160-ft. distillation towers shown above.

Minnesota Mining & Mfg. Co. will incorporate facilities to make its "Kel-F" line of chemicals in the new plant that the firm is now building at Decatur, Ala. After the Decatur plant goes on stream next spring, the company will curtail manufacture of the chemicals at

DOW | INSULATION



In the refrigeration machine room of the Hoffman-LaRoche plant, Styrofoam insulation prevents condensation on protected pipes. Moisture cannot impair its permanently high insulating efficiency.

STYROFOAM® PREVENTS CONDENSATION

even where temperatures range 120 degrees in one pipe!

"Because Styrofoam is its own vapor barrier and is readily installed at low cost, we specify it exclusively where subnormal temperatures are involved," asserts Charles Wright, project engineer for Hoffman-LaRoche Inc.

The Nutley, New Jersey, plant began using Styrofoam* eight years ago, both for additions to the cooling systems and for replacement of another material which frequently developed defects. Today, 50% of all brine and chilled water lines are insulated with Styrofoam.

"The greatest possible demands are made on the insulation," Mr. Wright continues. "We not only have two systems, zero and −30°F., but we also have dual-temperature applications where Styrofoam must effectively insulate pipes with brine passing through at 0°F. and at 120°F. at different times. Such extremes put the moisture and vapor resistance of the insulation system to a severe test."

Notice in the photo above the ice build-up on a section of the line left exposed for service purposes. Because of the moisture-resistant qualities of Styrofoam—because it stays dry inside—condensation which may creep along the pipe, even when a mastic sealer is used, does not impair its insulating efficiency. And since Styrofoam insulation is an effective moisture and vapor barrier, moisture does not penetrate *through* the insulation.

"Our installation costs have been reduced substantially by the use of Styrofoam, too," reports Mr. Wright. "It is readily placed in position and secured to the pipe. No special pipe supports are required, because the weight factor of Styrofoam is practically negligible—only 2.4 ounces per board foot."

Styrofoam is supplied by Dow to the fabricators listed below—pipe and vessel insulation experts who make both standard and special coverings. For complete information call the fabricator near you. Or write THE DOW CHEMICAL COMPANY, Midland, Mich., Plastics Merchandising Dept. 1649AK9-19.

Dow's registered trademark for its expanded polystyrene.

PIPE AND VESSEL COVERING FABRICATORS

DAL-VIR INC., Elkhart, Indiana • GLO-BRITE, Chicago, Illinois • KENNEDY INDUSTRIES, Los Angeles, California • KRANSCO MANUFACTURING COMPANY, South San Francisco, California • MMM, INCORPORATED, Houston, Texas • ROBINSON INDUSTRIES, Coleman, Michigan • STYRO FABRICATORS, Kansas City, Kansas • STYROFORMICS, INC., Somerville, Mass. • STYROPLASTICS, INCORPORATED, Minneapolis, Minnesota • TUFFLITE PLASTICS, INC., Ballston Spa, New York

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THE DOW CHEMICAL COMPANY • MIDLAND, MICHIGAN

SPECIAL MESSAGE FOR COLOR CHEMISTS...

ABOUT

THE IMPORTANCE OF

PIGMENT PARTICLE SIZE

to the proper pigmentation of your products . . .

Color, tinting strength, hiding power, oil absorption, dispersability, ease of grinding, suspension, freedom from abrasion, reactivity . . . these and other essential properties of pigments and extenders are directly related to pigment particle size.

In Williams' *synthetic* pigments—kroma reds; pure red, yellow, black and brown iron oxides; chromium oxides; and albacar calcium carbonates—particle size is carefully controlled at time of manufacture. Oversize is eliminated. Each of these types is available in a broad range of particle sizes.

With *natural* pigments, Williams produces specially sized materials, including VVF red oxides, metallic browns, siennas, umbers, and sparmite (super fine Barytes). Here again oversize is eliminated.

Below are the ranges of particle size distribution available for Pure Red Iron Oxides and Barytes. Other pigment groups have similar distribution ranges. For complete technical data, write Dept. 62, C. K. Williams & Co., 640 N. 13th St., Easton, Penna.

% BY WT. BELOW INDICATES SIZE

Micron Diameter	Pure Red Oxide		Barytes	
	Light	Dark	Sparmite	No. 1 Barytes
40	100	100	100	99.8
30	100	100	100	99.0
20	100	100	100	88.5
15	100	100	100	73.0
10	99.9	99.3	97.5	57.0
7.5	99.2	98.3	87.0	47.5
5	98.2	84.9	66.5	36.0
4	97.7	74.5	55.0	30.0
3	97.2	25.2	43.0	24.0
2	96.2	7.3	29.5	17.5
1	90.6	5.6	15.0	10.5
0.5	78.0	4.9	7.0	5.0

WILLIAMS
COLORS & PIGMENTS

"Pigment Technology at its best"

C. K. WILLIAMS & CO. / EAST ST. LOUIS, ILL. / EASTON, PA. / EMERYVILLE, CAL.

its plant in Jersey City, N. J., where they are currently made. Other products to be made at Decatur will include stain repellers and specialty chemicals.

Linde Co., division of Union Carbide Corp., will install an on-site oxygen plant at The Colorado Fuel & Iron Corp.'s steel mill in Pueblo, Colo. Output will be over 200 million cu. ft./mo.

Stauffer Chemical Co. will build a chlorine plant in the Wilmington area of Los Angeles. Total chlorine output will be supplied to American Chemical Corp. (owned jointly by Stauffer and Richfield Oil Co.) as raw material for making vinyl chloride, ethylene chloride and ethylene dichloride, and Stauffer itself will consume the by-product caustic.

Syntex Laboratories, Inc., will build a scientific center at Palo Alto, Calif., which will be devoted to basic research in nucleic acids and analogous compounds. Expected to be in full operation early next year, it will be Syntex's first research installation in the U. S. Eli Lilly & Co. will also participate in the nucleic-acids program, at the new Palo Alto facility and also at its own laboratories in Indianapolis.

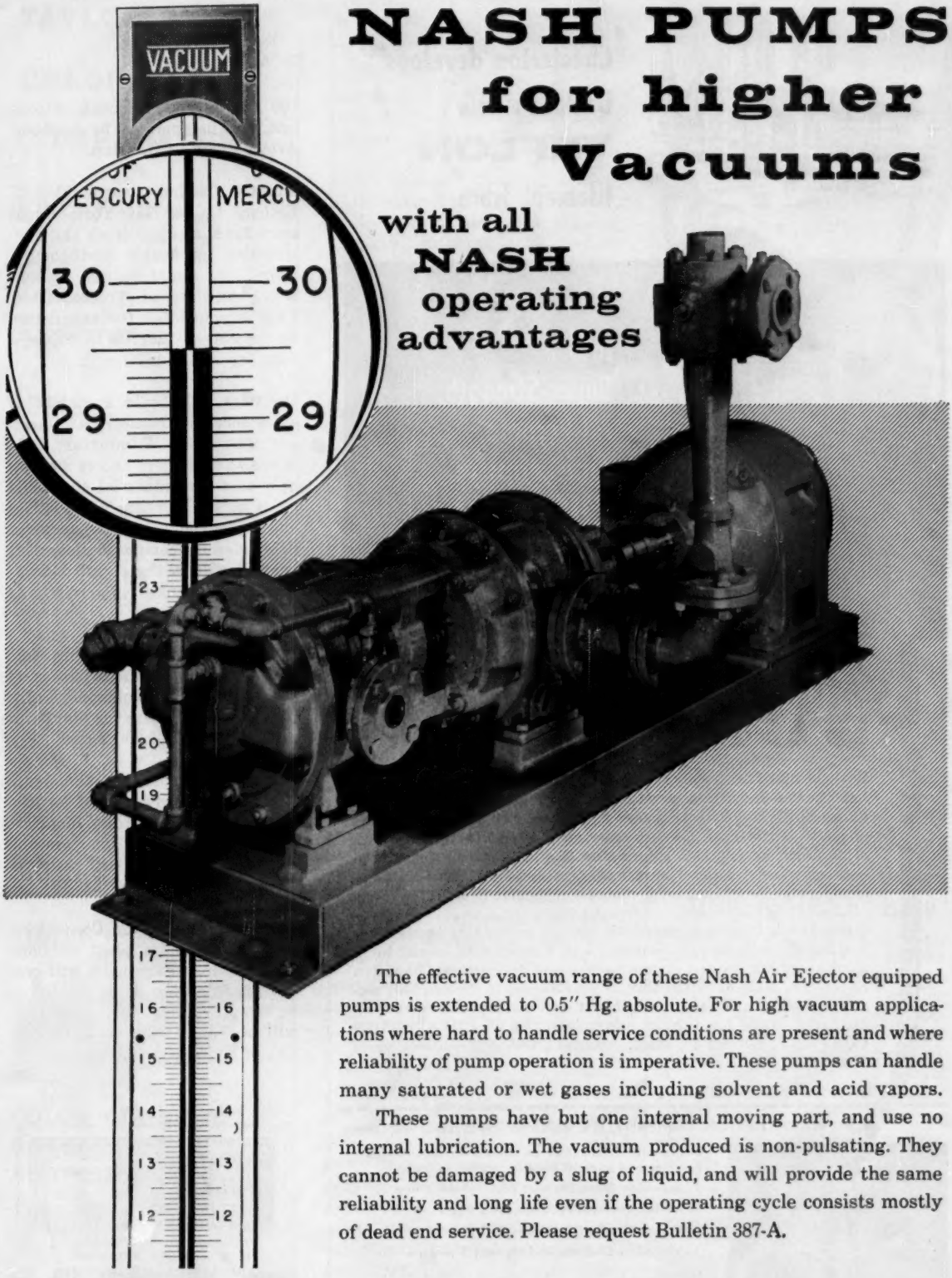
Allied Chemical Corp.'s Plastics and Coal Chemicals Div. is substantially expanding phthalic anhydride production capacity at its Philadelphia plant. The new capacity is due to be available early next year.

Tennessee Corp.'s U. S. Phosphoric Products Div. has announced expansion plans that will increase its phosphate products output by 50%. The project is expected to be completed by late 1961 or early 1962.

Linde Co. announces that its Town of Tonawanda facilities will engineer and build a large on-site oxygen plant for the Sheffield Steel Div. of Armco Steel Corp. Plant will be able to supply up to

NASH PUMPS for higher Vacuums

with all NASH operating advantages

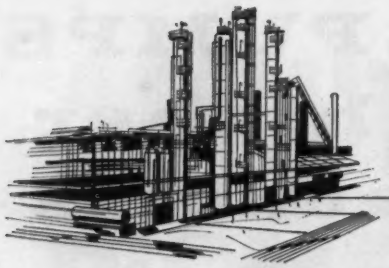


The effective vacuum range of these Nash Air Ejector equipped pumps is extended to 0.5" Hg. absolute. For high vacuum applications where hard to handle service conditions are present and where reliability of pump operation is imperative. These pumps can handle many saturated or wet gases including solvent and acid vapors.

These pumps have but one internal moving part, and use no internal lubrication. The vacuum produced is non-pulsating. They cannot be damaged by a slug of liquid, and will provide the same reliability and long life even if the operating cycle consists mostly of dead end service. Please request Bulletin 387-A.

NASH ENGINEERING COMPANY

SOUTH NORWALK, CONNECTICUT, U. S. A.



Chesterton develops DuPont's new **TEFLON** filament fibre

into a Super-Strength, All-Purpose, Anti-Corrosive **CHEMICAL PACKING**

Chesterton Style 324 SUPER-LON

With 25 times the tensile strength of Teflon resin packings, Super-Lon is the industries newest and most glamorous all-purpose Chemical Packing. Super-Lon has all the known advantages of Teflon *plus* 50,000 psi tensile strength contrasted to 2,000 psi limitations in older Teflon Resin styles. Here at last is a pure, strong Teflon fibre packing which runs cool on the shaft, stands heat to 550°F, and incorporates the lubrication advantages of regular Braided Packings.

Super-Lon is inert to all chemicals (except molten alkali metals), is braided for softness and resilience and, treated with special high-shaft-speed lubricants resistant to corrosive destruction. Chesterton Super-Lon, made of Teflon fibre, is your answer to the toughest corrosive problems. It has proven that it cuts maintenance costs spectacularly. Write for further information. A. W. CHESTERTON COMPANY, Everett 49, Mass. America's Oldest Manufacturer of Mechanical Packings.

A. W. CHESTERTON COMPANY, 22 Ashland St., Everett 49, Mass.

Please rush information on Chesterton Color-Coded Packings and name of local distributor —

- ☐ Super-Lon Teflon Filament Packing—pH 1 thru 14
- ☐ Blu-Lon Chemical Packing—pH 1 thru 4
- ☐ Carson Chemical Packing—pH 5 thru 8
- ☐ White-Lon Chemical Packing—pH 9 thru 14

NAME

ADDRESS

CITY STATE

CPI BRIEFS . . .

100 million cu. ft./month of oxygen, will be operated by Linde at Armco's mill in Houston.

Sun Oil Co. has awarded M. W. Kellogg, Co., of New York, a contract for the engineering and construction of Sun's forthcoming $8-million naphthalene plant, which will be at Toledo, Ohio. Unit is scheduled for completion by the end of 1961; it will have a capacity of 100 million lb./yr.

Du Pont will build a $2-million sales service laboratory at Chestnut Run, near Wilmington, Del., to assist customers and to develop new uses for industrial chemicals made by the company's Industrial and Biochemicals Department. Scheduled for completion late next year, it will be the eighth laboratory on Du Pont's 160-acre site at Chestnut Run.

American Alkyd Industries has begun making synthetic resins at its new plant in Richmond, Calif. Company states that the plant will produce up to 500,000 lb./wk.

Monsanto Chemical Co. announces that its expanded facilities for producing globular sodium bisulfate at Everett, Mass., are now on stream. The expansion has increased production by 20%.

Champion Spark Plug Co. will expand its ceramics plant at Cambridge, Ohio. Expansion will cost over $2.5 million, is scheduled to be completed next spring. Project will be handled by H. J. Spieker Co., of Toledo, Ohio.

Sunray Mid-Continent Oil Co. plans to organize, as a wholly owned subsidiary, a new company to engage in chemical and petrochemical research, manufacturing

TAYLOR COLORIMETRIC COMPARATORS

give you fast accurate tests for pH, chlorine, phosphate in just 3 simple steps

COLOR STANDARDS GUARANTEED AGAINST FADING

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101 pages of technical data and useful information. Gives theory and application of pH control. Describes Taylor line.

W. A. TAYLOR AND CO.
414 STEVENSON LANE • BALTIMORE 4, MD

CPI BRIEFS . . .

and sales. It will be called Sunray Chemical Co., will have headquarters in Tulsa, Okla.

Witco Chemical Co., Inc., of New York, has acquired 100% interest in Sonneborn Chemical & Refining Corp. and its subsidiaries. Sonneborn, which will continue under independent operation in the Witco organization, has refining facilities at Petrolia, Pa., and Franklin, Pa., as well as a chemical specialty plant at Belleville, N. J.

Pennsalt Chemicals Corp., of Philadelphia, is acquiring a substantial interest in the Dutch chemical firm N. V. Fabriek van Chemische Producten Vondelingenplaat. Facilities to make Pennsalt products will be erected at the Vondelingenplaat plant near Rotterdam, and Pennsalt will also manufacture some of the Dutch company's products in the U. S., Mexico, Canada and other countries where Pennsalt has subsidiaries.

Walworth Co., of New York, has formed a new lubricated-plug-valve sales and service division, with headquarters in Houston.

Houston Chemical Corp., subsidiary of Chatham-Reading Corp., has acquired the former automotive chemicals department of Commercial Solvents Corp., will handle the department's antifreeze and other products sold under the Peak trade name.

OVERSEAS BRIEFS

Italy: Shareholders of Montecatini Soc. Gen., of Milan, have recently approved the merger into Montecatini of Vetrocoke Co., a Venice-based manufacturer of nitrogen fertilizers, glass and coke products. At the same time, the shareholders approved a 50% increase in the company's capital stock, from 100 billion lire to 150 billion

PREMIER

DISPERSATORS

mixers with the patented "MICRO-SHEAR" head

FEATURE: double shearing •balanced operation at much higher speeds than conventional mixers •high intensity mixing •smaller particle sizes than conventional mixers •lower power requirements •adjustments to control aeration or injection of gases into liquids • slotted head achieves quality dispersion

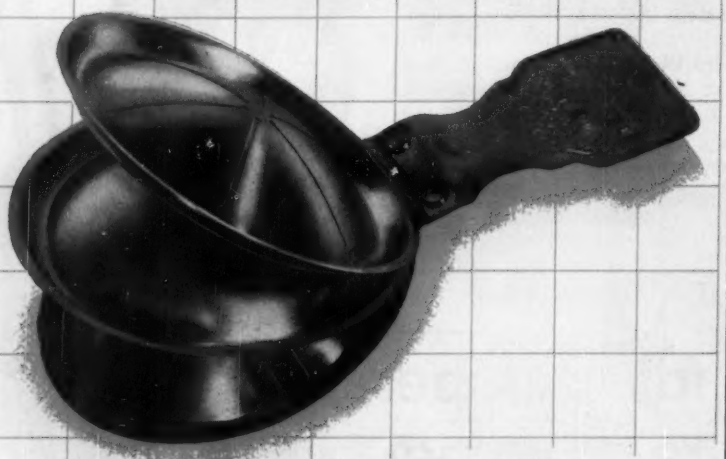
Think of what these features mean to you

REDUCED PROCESSING and RETENTION TIME!

Contact Premier for complete engineering service on any mixing problem

PREMIER MILL CORP.
224 C Fifth Ave., New York 1, N.Y.

"Difficult" Pressure Protection Problems?



Solve Them With...

BS&B *Safety Heads!*

BS&B's D and DV Rupture Discs, which are fully interchangeable in BS&B Safety Head flanges with conventional type pre-bulged discs, are engineered to give highly desirable Safety Head protection to those pressured systems in which one or more of the following "difficult" conditions prevail:

1. When operating pressure must be close to relief pressure.
2. When high operating temperatures are involved.
3. When alternating pressure and vacuum prohibits the use of standard one-layer rupture discs.
4. When pulsating pressure conditions prevail.
5. When a combination of metal and plastic disc construction is needed to obtain lower rupture pressures.

BS&B D and DV Rupture Discs have these advantages:

1. Fast action and unrestricted relief openings.
2. Wider rangeability in selection of metals and plastics for disc components.
3. Longer service life.
4. Rugged construction for added protection against possible damage by rough handling.

BS&B — ANOTHER EXAMPLE OF PRODUCT LEADERSHIP

Let BS&B Safety Heads solve your pressure protection problems. Our engineers will gladly evaluate your pressure system to assist you in proper selection of Safety Heads.

BLACK, SIVALLS & BRYSON, INC.

Safety Head Division, Dept. 2-DX11
7500 East 12th Street
Kansas City 26, Missouri
Telephone: BEnton 1-7200

CPI BRIEFS . . .

lire. Montecatini will issue 50 million additional capital shares to effect the increase, of which 8½ million will be issued in connection with the Vetrocoke merger.

Mexico: The Anaconda Co., of New York, and Southwestern Engineering Co., of Los Angeles, are starting up a new $2-million plant in Guadalajara to manufacture heat exchangers, ejectors, distillation columns, evaporators and other equipment for chemical and mineral processing. Plant belongs to a new company called Swecomex, S.A., which has a majority of its capital under Mexican control.

Poland's aluminum industry is taking giant strides, as evidenced by recent announcements of new facilities. A $42-million plant to produce aluminum oxide from bituminous and argillaceous slates will be completed this year at Gorka; it will supply major part of the requirements of the Skawina aluminum works near Krakow, which now imports all its aluminum oxide. A $29-million aluminum plastic processing works and rolling mill, due for completion by 1965, is currently under construction in Katy, near Skawina. An aluminum foundry, to cost about $18 million, is being planned for Maliniec, near Konin; its annual output is to be 100,000 tons, and construction will start in 1962. And an aluminum semiproducts refining plant and an anodic mass factory will be built at the same location.

England: A new London-based company, owned jointly by Shell International Chemical Co. Ltd. and National Distillers & Chemical Corp., New York, will produce polyolefin film and plastics packaging materials at undisclosed locations outside the U.S. and Canada. The move represents Shell's first venture into the finished-plastics field.

Portugal: Catalytic cracking and related facilities of the SACOR (Sociedade Anonima Concessionaria da Refinagao de Petroleos en

HANDLES 32% HCl AT AMBIENT TEMPERATURES—Workman is painting a section of Fibercast Pipe bearing 32% HCl at a Shell chemical plant. Note that Fibercast has sufficient strength for installation on span racks with the spacing normally used for metal pipe.

New pipes handle temperatures and pressures where no other pipes will do

WHAT is Fibercast?

It is a centrifugally cast, thermoset, epoxy resin reinforced pipe that handles temperature and pressure problems where no other non-metallic pipe will do. Its body of woven glass fibers resists high tension forces, is imbedded and bonded by heat in epoxy resin. Result: strong, long-lasting pipe that resists high pressure and temperatures in corrosive environments.

WHERE should Fibercast be used?

The petroleum industry . . . chemical . . . petro-chemical . . . nuclear energy . . . textile . . . paper . . . and food-processing industries . . . countless operations handling acids, alkalies, salt water and other corrosive liquids under pressure.

Wherever ease of handling, lightweight, dielectric properties and structural stability are desirable in a material that is at the same time outstandingly resistant to heat, pressure and corrosion.

WHY use Fibercast?

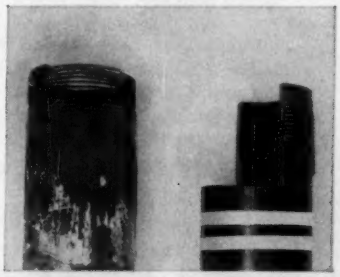
Because its advantages of superior resistance to heat, pressure and corrosion give Fibercast long service life that would alone justify choosing it over other materials.

Because even more expensive metal pipe or pipe with thermoplastic interior coatings cannot match Fibercast's proven durability.

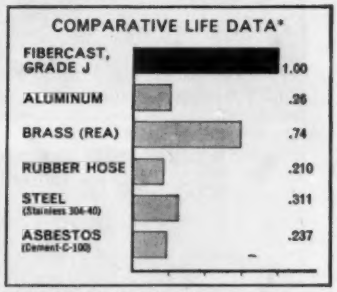
Because case histories and accurate testing have proved over and over again that Fibercast performs better, lasts longer, costs less.

Because out of 338 common corrosive solutions, Fibercast competently handles 320.

And, naturally, because Fibercast's unique and lasting qualities under such conditions mean that it drastically reduces maintenance and replacement costs, too.



Fibercast Tubing (right) used to suspend a 1,200 lb. pump for 3 years in a salt water supply well. *There was no loss in strength.* The damaged plastic-coated steel nipple (left) was used in the same installation, failed after 3 months service.



**Basing Fibercast as unit life of 1 and others as comparative percentages thereof.*

Remember, also, that the three major systems of joining all pipe are used with equal success on Fibercast (standard flanged, cemented, and threaded and coupled), and with a complete selection of Fibercast Fittings. It's the world's largest line of corrosion-resistant epoxy pipe fittings!

To receive a free sample of Fibercast, to learn more of the details, and to get specific information about how Fibercast can help *you*, mail the coupon below.

FIBERCAST COMPANY CE-9A
Box 727, Sand Springs, Okla.

Please send me further information about Fibercast Tube and Pipe.

Name _____

Title _____

Firm _____

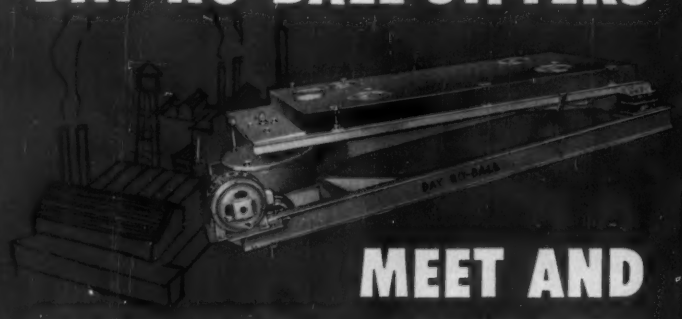
Type of Business _____

Address _____

City _____ Zone _____ State _____

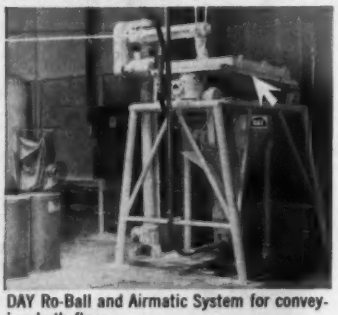
FIBERCAST® COMPANY — A DIVISION OF **Youngstown** SHEET AND TUBE COMPANY

DAY RO-BALL SIFTERS

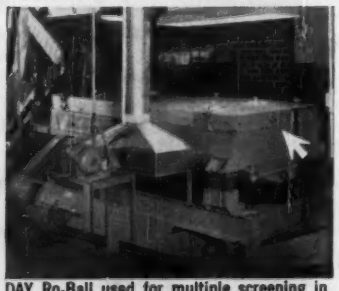


MEET AND KEEP GOOD COMPANY

DAY Ro-Ball Sifter installed in combination with DAY Ribbon Blender



DAY Ro-Ball and Airmatic System for conveying bulk flour



DAY Ro-Ball used for multiple screening in large tobacco plant

You are in good company when you specify DAY Ro-Ball Sifters. The most respected names in American industry today make the DAY Ro-Ball their solid choice for efficient, low cost, high production sifting equipment.

Over 2000 DAY Ro-Balls are in operation, on an extremely wide range of materials, wet and dry. The high rate of repeat orders, by company after company, testify to their reliability and efficiency.

Available in a complete range of models and sizes, including stainless steel units to meet food and dairy sanitary codes. DAY Ro-Balls are often combined with allied DAY equipment to reduce materials handling and save floor space.

Call in a DAY engineer to help solve your sifting problems. Use the DAY laboratory testing facilities to determine the RO-Ball Sifter that best meets your needs.

For complete sifting and screening data, write today for new DAY Ro-Ball Bulletin.

The **J. H. DAY** *Co.*

Division of The Cleveland Automatic Machine Co.

4926 Beech St., Cincinnati 12, Ohio

Quality Mixing, Blending, Milling and Sifting Machines since 1887

DAY

CPI BRIEFS . . .

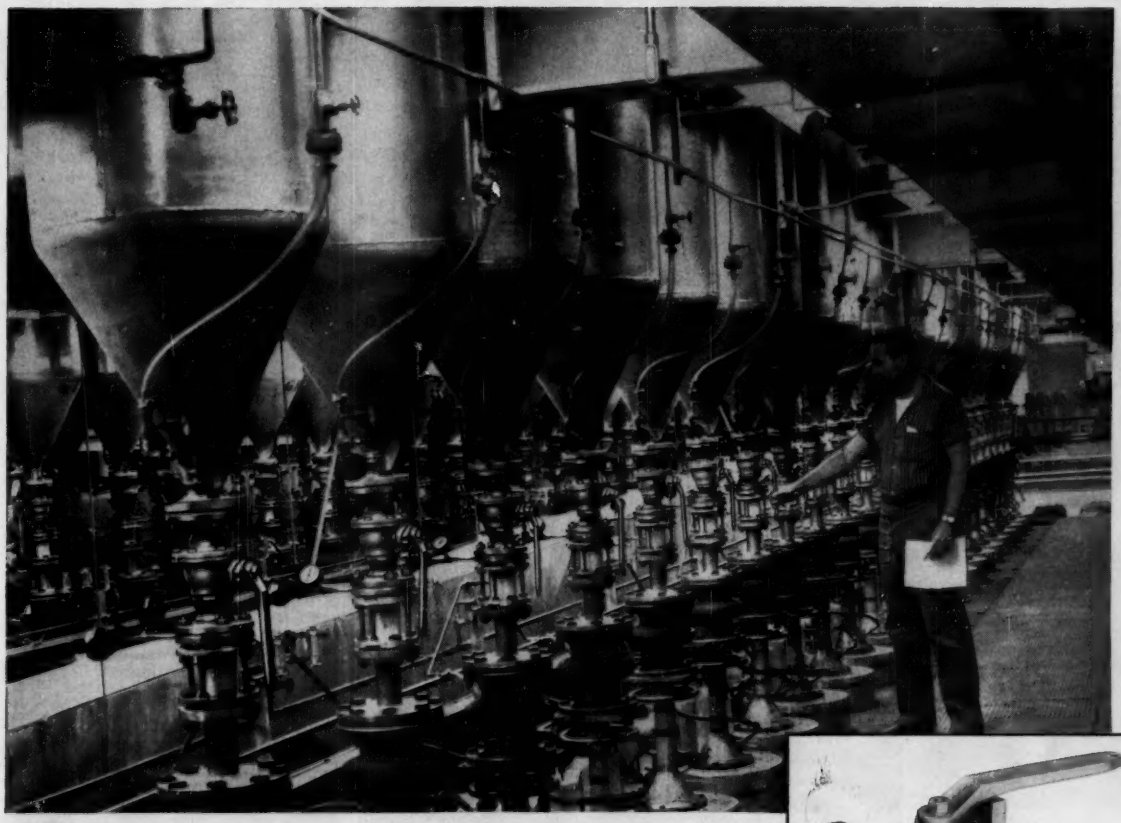
Portugal) refinery near Lisbon will be expanded to increaes output of liquefied propane and butane. Project will be handled by Hydrocarbon Research, Inc., of New York.

Japan's industrial picture is being expanded by the following recently announced developments in the chemical process field. Oronite Chemical Co., of San Francisco, and Nippon Petrochemicals Ltd. will join in building the country's first detergent polymer and alkylate plant. It will be in Kawasaki, near Tokyo, and is scheduled for completion late next year. A newly created company, Nippon Petroleum Detergent Co. Ltd., will operate the facility, using Oronite patent licenses and know-how. And three new chemical plants are slated for the growing petrochemical center at Yokkaichi, in central Japan: Ajinomoto plans a $36-million plant to produce its food-seasoning essence from acrylonitrile (*Chem. Eng.*, May 2, 1960, p. 51), High Molecular Chemical Co. will build a $1.6-million synthetic-resin facility, and Edogawa Chemical Co. will invest $1.6 million in a plant to make hydrogen peroxide and polycarbonate resins.

India: Standard Vacuum Oil Co. has submitted plans to the Indian government for a $9-million lubricants plant, to be set up on a 50-50 partnership basis with either the government or another Indian investor. Plant would be at Bombay, would process feedstock from Stanvac's Bombay Refinery to produce 700,000 bbl./yr. of high-quality oil for automotive and industrial use.

Israel: Construction will start soon on a $1.1-million plant at Tel-Aviv to produce fertilizers from garbage. Half of the investment will come from RASSCO, a Tel-Aviv industrial, commercial and contracting company; the rest is being put up by a group of unidentified U. S. investors. Plant will be built by Dorr-Oliver of Amsterdam (Holland), is to go on stream within about 14 months.

They broke up the pellet traffic jam...



with Rockwood Ball Valves

A costly and recurrent problem in a large southern synthetic fibre mill was the jamming of polymer pellets as they came from supply hoppers. Source of the trouble was the tapered-throat design of the valves. Even with valves fully open, pellets piled up. In addition, this packing-in action caused severe abrasion on the valves. The problem was solved by replacement with Rockwood Ball Valves. Their *straight-through-opening* feature now permits pellet to flow smoothly . . . and the wear problem has been automatically eliminated because Rockwood valves offer no more resistance to flow than the pipeline itself.

What's more, after hundreds of openings and closings Rockwood Ball Valves still provide *positive leak-proof* shut-off means. A retainer spring, which *automatically compensates for pressure variations* keeps the seat snug against the ball and holds tight even under vacuum.

Thousands of Rockwood Ball Valves are giving efficient service and cutting costs throughout industry — in oil refineries, textile mills, paper, chemical and rubber plants.

There are types and sizes to meet every requirement in *your* plant. Write today for the illustrated folder on Rockwood Ball Valves. Tested and listed by Underwriters' Laboratories, Inc. Rockwood Sprinkler Division of the Gamewell Company. *A subsidiary of E. W. Bliss Company,* 263 Harlow St., Worcester 5, Mass. Distributors in principal industrial areas.

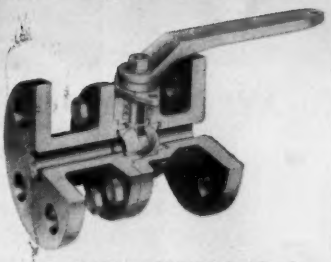


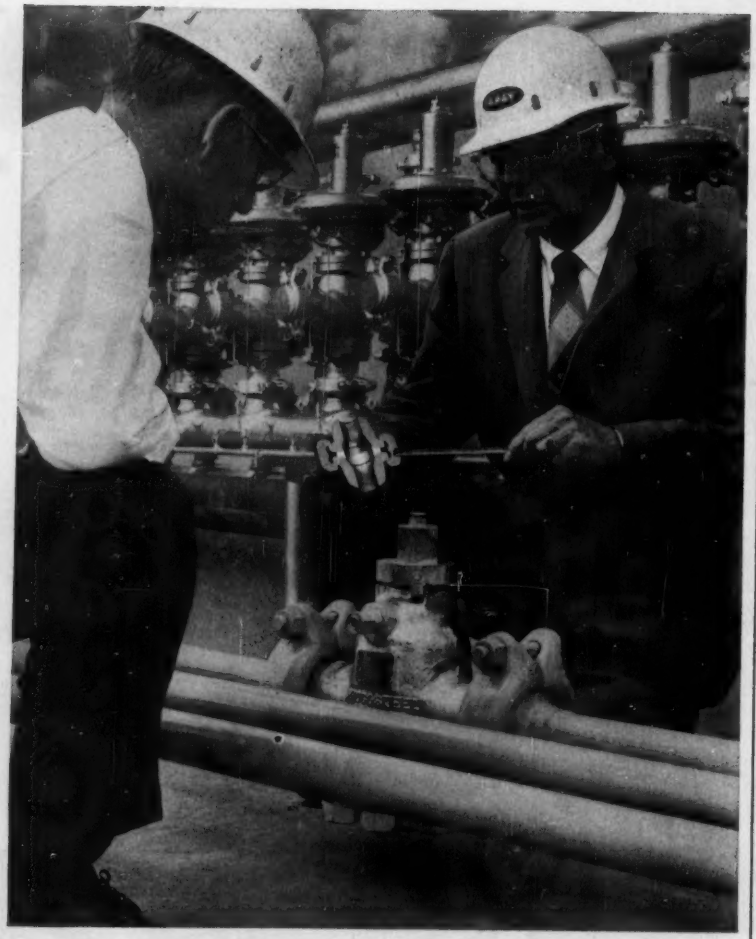
Fig. 254 Type 316 Stainless Steel

Rockwood Ball Valves are available in pipe sizes ¼" through 16" in screwed ends 150 lb. and 300 lb. flanges. All internal parts are of Type 316 stainless steel with spring-compensated TEFLON* seats. Recommended for 600 p.s.i. working pressure and suitable for temperatures ranging from—100° F. to 400° F. All sizes are available with two retainer springs and two Teflon seats.

*DuPont Reg. T. M.

ROCKWOOD BALL VALVES

FULL, ROUND FLOW



GRAYLOC® Seal: Leak-proof at any pressure

Leak-proof quality of GRAYLOC Seals in piping applications has been use-proved from full vacuum to 30,000 psi and test-proved up to 150,000 psi. Holding at any pressure makes GRAYLOC practical in applications requiring positive leak-proof connections.

The GRAYLOC Seal is available in two-bolt clamp-type or conventional flange connections. Its simple steel design features a rigid rib with lips on either side tapering slightly less than the mating hub to form a line seal at the touchpoint. As the connection is tightened, the lips deflect to form a surface seal. GRAYLOC connections provide a permanent steel seal that can be made up repeatedly, operating to pressure without seal ring replacement. Stock connections available from ½" to 30" and on special order in corrosion-resistant metals.

If you want to know more about how GRAYLOC Connections can permanently solve your leakage problems, write for the new GRAYLOC CATALOG on your company letterhead.

GRAYLOC SALES DIVISION

GRAY Tool Company

P. O. BOX 2291 HOUSTON 1, TEXAS Riverside 7-1240 08

Convention Calendar

September

18-21. American Society of Mechanical Engineers, Petroleum Mechanical Engineering Conference, Jung Hotel, New Orleans, La.

21-23. American Society of Mechanical Engineers and American Institute of Electrical Engineers, Power Conference, Bellevue-Stratford Hotel, Philadelphia, Pa.

22-23. The Chemical Market Research Association, Fall Conference, "The European Chemical Industry," Wentworth-by-the-Sea, Portsmouth, N. H.

25-28. American Institute of Chemical Engineers, National Meeting, Mayo Hotel, Tulsa, Okla.

26-30. Instrument Society of America, Instrument - Automation Conference and exhibit, Coliseum, New York, N. Y.

29-30. Southern Research Institute, "Tomorrow's Transportation," Dinkler-Tutwiler Hotel, Birmingham, Ala.

27-1. International Electrostatics Conference, University of Grenoble, Grenoble, France.

October

5. Society of Plastics Engineering, Inc., Plastics vs. Corrosion, Mark Hopkin Hotel, San Francisco, Calif.

6-8. American Association of Textile Chemists and Colorists, 1960 National Convention, Sheraton Hotel, Philadelphia, Pa.

6-7. National Association of Corrosion Engineers, regional conferences, West, Sheraton-Palace Hotel, San Francisco, Calif.

6-8. Southeast, Dinkler-Plaza Hotel, Atlanta, Ga.

11-14. Northeast, Prichard Hotel, Huntington, W. Va.

19-20. North Central, Pfister Hotel, Milwaukee, Wis.

25-27. South Central, Mayo Hotel, Tulsa, Okla.

6-8. American Ceramic Society, Refractories Division Meeting, Bedford Springs Hotel, Bedford, Pa.

9-12. American Society of Mechanical Engineers, Rubber and Plastics Conference, Hotel Lawrence, Erie, Pa.

9-13. Electrochemical Society, Annual meeting, Shamrock Hotel, Houston, Texas.

11. National Petroleum Association, Symposium on Non-Newtonian Viscometry, Mayflower Hotel, Washington, D.C.

12-14. American Vacuum Society, 7th National Symposium, Cleveland-Sheraton Hotel, Cleveland, Ohio.

12-14. Industrial Management Society, 9th Annual Methods Improvement Clinic, Conrad Hilton Hotel, Chicago, Ill.

13-14. Industrial Management Society, 24th Annual National Industrial Engineering and Management Clinic, Conrad Hilton Hotel, Chicago, Ill.

13-14. The Society of the Plastics Industry, 16th Annual New England Section Conference, Wentworth-by-the-Sea, Portsmouth, N. H.

November

14-16. National Association of Corrosion Engineers, regional conference, Sheraton Mount Royal Hotel, Montreal, Quebec.

16-19. American Oil Chemists' Society, Annual Convention, Hotel New Yorker, New York, N. Y.

17-19. American Society of Mechanical Engineers & American Society of Lubrication Engineers, 7th Annual Lubrication Conference, Statler-Hilton Hotel, Boston, Mass.

17-19. Technical Assn. of the Pulp and Paper Industry, 15th Plastics-Paper Conference, Hotel Syracuse, Syracuse, N. Y.

17-19. Institute of Radio Engineers, 1960 Symposium on Adaptive Control Systems, Garden City Hotel, Garden City, L. I., N. Y.

17-21. American Society for Metals, 1960 Metal Show, Philadelphia Trade and Convention Center, Philadelphia, Pa.

19-26. International Plastics Exhibition, Ulrecht, The Netherlands.

20-21. Air Pollution Control Assoc., West Coast Section, 2nd Technical Meeting, Santa Barbara Biltmore Hotel, Santa Barbara, Calif.

23-27. Technical Assn. of the Pulp and Paper Industry, 156th Engineering Conference, Robert Meyer Hotel, Jacksonville, Fla.

24-26. Canadian Manufacturers of Chemical Specialties Assoc., 3rd Annual Meeting and Conference, Queen Elizabeth Hotel, Montreal, Quebec.

25-27. American Standards Association, 11th National Conference on Standards, Sheraton-Atlantic Hotel, New York, N. Y.

26-27. Illinois Institute of Technology, 1960 Computer Applications Symposium, Morrison Hotel, Chicago, Ill.

27-28. The Fiber Society, Fall Meeting, Washington Hotel, Washington, D. C.

28. American Institute of Chemical Engineers, South Texas Section, 15th Annual Technical Meeting, Rice Hotel, Houston, Texas.

31. American Management Association, Packaging Management Course, Hotel Astor, New York, N. Y.

November

3-4. American Production and Inventory Control Society, 3rd Annual National Conference and Technical Exhibit, Sheraton-Cadillac Hotel, Detroit, Mich.

7-9. The Chemical Institute of Canada, Canadian Chemical Engineering Conference, Quebec City, Canada.

8-10. The Material Handling Institute, Inc., Material Handling Institute Central States Show, The Kentucky Fair and Exposition Center, Louisville, Ky.

9-10. The Chemical Market Research Association, Annual Meeting, Pittsburgh Hilton Hotel, Pittsburgh, Pa.

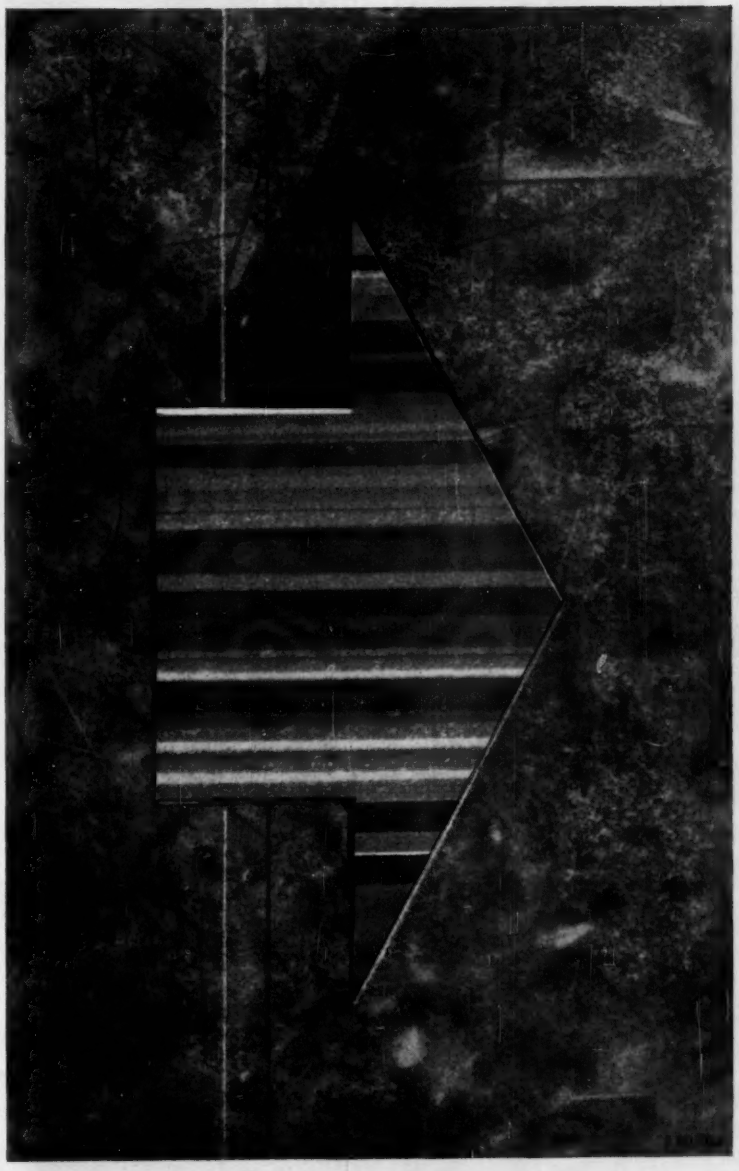
15-16. Purdue University, Symposium on Engineering Applications of Probability and Random Function Theory, Lafayette, Ind.

20-22. Fluid Controls Institute, Inc., Fall Meeting, Drake Hotel, Chicago, Ill.

29-30. Midwest Research Institute and CHEMICAL ENGINEERING Symposium on new techniques in mathematics, chemistry and engineering as applied to modern chemical engineering practice, Hotel Muehlbach, Kansas City, Mo.

28-2. American Society of Mechanical Engineers, 24th National Exposition of Power and Mechanical Engineering, New York Coliseum, New York, N. Y.

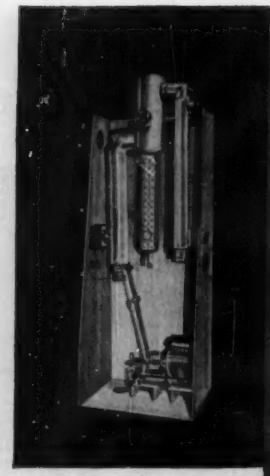
A new development in air dynamics!



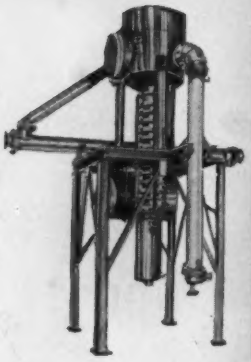
A NEW FAN. Today's airfoil centrifugal fan performance in a new space-saving shape. Uses less than half the installed space of conventional centrifugal fans. Interested? Watch for an October announcement.

Our new space-saving centrifugal fan and catalog will be available in October. Why not write now and reserve a copy of the catalog? You can be sure if it's Westinghouse. Sturtevant Division, Hyde Park 36, Massachusetts.

Westinghouse



the
ARTISAN
evaporator
stripper...



HOW IT WORKS: Contaminated solvent is pumped or gravity-fed to a steam-heated evaporator where 80–90% of the solvent is evaporated in a single pass. Vapor is separated in a vapor chamber. Liquid then flows to jacketed tube and disk stripping column where remaining contaminants are removed. Vapor proceeds to condenser where it returns to pure solvent.

RECOVERY RATE- *99% plus*
COST- *less than a penny a gallon*

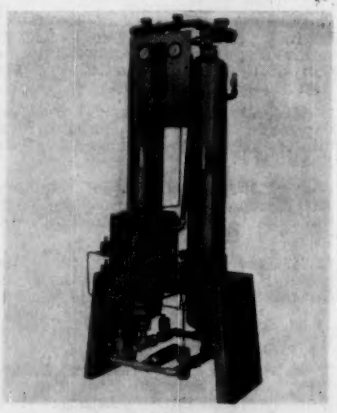
This newly designed Artisan system is particularly useful for recovering chlorinated hydrocarbons from relatively non-volatile contaminants with a high rate of solvent recovery on a continuous basis.

You can obtain recovery rates of 98–99% without stripping steam. With steam, recovery rate climbs to 99.9%. Based on figures from the field, cost is less than one cent per gallon.

Applications: hydrocarbons; plasticizers, glycerine, fatty acids, heavy concentrates, heat-sensitive materials like vitamins, separating solvents from greases and resins, removing volatiles from polymers.

For complete information write:
ARTISAN METAL PRODUCTS, INC.
76 Pond Street, Waltham 54, Massachusetts
A MEMBER OF ARTISAN INDUSTRIES

NEW EQUIPMENT . . .
Continued from p. 120



Air and gas dryer

Power on or off, desiccant goes goes right on with drying.

Known as Heat-Les, a desiccant-type dryer now features a system for safety protection after power failure. Upon loss of power, both chamber inlet valves open. Simultaneously, purge valves automatically close. Gas to be dried then passes through both chambers into the effluent outlet.

Time period of emergency operation is claimed to be longer than can be obtained with comparable-sized heat-reactivated unit. Dryer resumes normal operation when power is restored.—**Trinity Equipment Corp., Cortland, N. Y.** 238A

Floating-cone valve

Seat surface is never scored as valve can't be overtightened.

Positive shutoff and "no-galling" seal are features of a new floating-cone hand valve for liquid and gas service on meter manifolds, seal chambers, hydraulic equipment and similar applications.

Instead of conventional one-piece plug and stem, the stem on the new valve terminates in a socket which holds the knuckle of a conical plug. When the plug is firmly seated, the stem is free to rotate. No amount of further

tightening will score the polished cone.

Available in five variations of globe and angle type, the ¼-in. valve will hold line pressures up to 3,000 psi. Stem and packing gland are stainless, body and bonnet are heavy-duty steel. The valve uses Teflon packing rings.—**The Foxboro Co., Foxboro, Mass.** 238B

Vacuum gage

Nonlinear calibration spreads lower-range readings.

A new mechanical diaphragm gage for vacuum service requires no electrical connections, reads vacuum from atmospheric pressure to 0.2 mm Hg.

Change in pressure deflects a corrugated copper-beryllium diaphragm, which in turn actuates a pointer through mechanical linkage. The circular scale, calibrated in mm. Hg, has a nonlinear calibration which spreads the 20-0.2 mm. range over 180 deg. of the dial face.—**Consolidated Vacuum Corp., Rochester, N. Y.** 239A

Gasket material

Inert to most chemicals, it has wide temperature range.

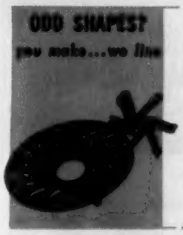
Gasket and packing materials made of fluorocarbon resins and inorganic fibers can be used at temperatures from —425 F. to 500

Life in these excited states...

"Glad to see you're a man with ideas, Henry"

Why men with ideas choose ACE equipment

High-impact, rubber-plastic, most economical for average chemicals. ½ to 6". Screw or solvent welded fittings. Valves ½ to 2". NSF-approved. *Bul. 80A.*



Rubber or plastic lining is economical life insurance for costly "special" equipment. It's a specialty with ACE. Write for *Bul. CE-53.*

Choice of Riviclor PVC, Ace-Ite rubber-plastic, Ace polyethylene or Ace Saran to match *any* plastic pipe. Sizes ½ to 2". Also larger plastic-lined valves.

Leading chemical design and development men work in the future... with no time to go back over specifications for equipment that didn't work out. You'll find they reach for Ace corrosion-engineered equipment time and again...just to be *sure*. If equipment failures give *you* no time to think ahead, it's time to give us a call.

Ace-Hide, tough as a rhinoceros, insensitive to corrosives, makes this finest of acid pails. Also dippers, bottles, funnels, etc.

ACE *chemical resistant equipment*
BY AMERICAN HARD RUBBER COMPANY
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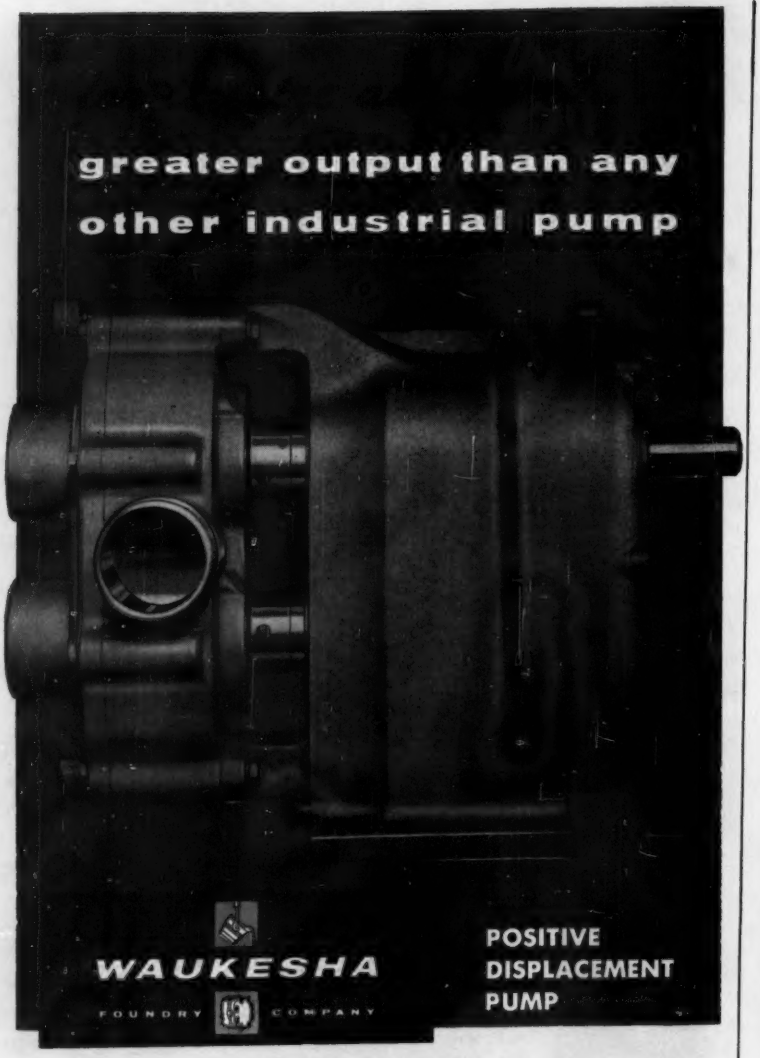
See ACE equipment in Chemical Engineering Catalog



A new "Waukesha" designed and engineered to deliver less turbulence, pulsation, aeration and agitation on products of high or low viscosity . . . a smoother operation which assures longer life, less maintenance.

ENGINEERING SERVICE

Waukesha offers a competent staff of engineers to aid you in your pumping problems. Representatives in all major cities, territorial managers, and direct factory representatives.

- **twin-balanced impellers**
- **single or dual mechanical seals (John Crane)**
- **interchangeable packing gland or mechanical seal construction**
- **self priming**
- **shaft supported by three heavy-duty bearings to eliminate deflection**
- **iron pipe or flange-type connections**
- **quick disassembly of pumping head**
- **helical timing gears**
- **off-shelf replacements**
- **max. capacity—100 G.P.M.; max. pressure—200 P.S.I.**

Write for Catalog P302

WAUKESHA FOUNDRY COMPANY

Dept. #108, Waukesha, Wisconsin

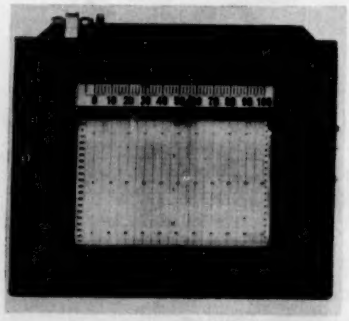
Export Sales: FMC International, San Jose, California (Cable Address: FOODMACHIN)

positive displacement pumps . . . centrifugal pumps . . . stainless steel valves and fittings . . . corrosion resistant castings

F. New materials, called Fluorocarbon Accopacs, are made by coating asbestos or other inorganic fibers with resins, using a patented beater saturation process.

Finished product combines the good dielectric properties, extreme chemical inertness and unusual heat resistance of the resins with the low coefficient of thermal expansion and high resistance to deformation of the fibers.

According to the manufacturer, Accopacs can be bonded to other materials with thermosetting or thermoplastic adhesives. Its low coefficient of friction makes it particularly useful for seals and packings in contact with moving parts.—**Armstrong Cork Co., Lancaster, Pa.** **239B**

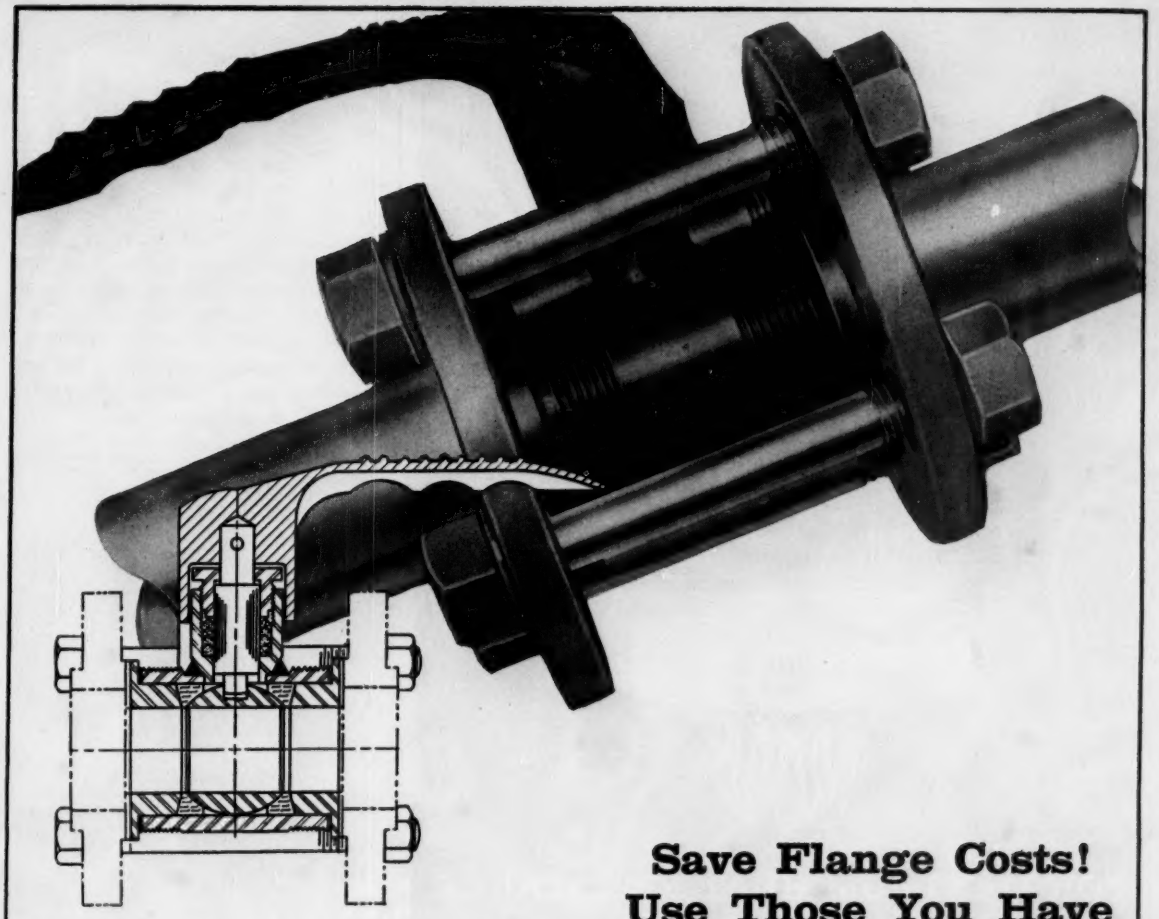


Refractometer

Compact instrument measures, records refractive indexes.

Another instrument that may lend itself to process control in new areas is a differential recording refractometer. Accurate to ½% full scale, it is a compact unit with both the optical system and strip-chart recorder contained in one case.

In operation, the unit is zeroed with a reference standard and the flowing sample, so that a beam of light traversing both reference and sample is split in half to shine equally on two photocells. Any change in the refractive index of the flowing sample causes the beam to shift, causing one photocell to get more light.



Save Flange Costs! Use Those You Have

Install Fullport Compression-Mounted Ball Valves in Seconds

Fullport Compression-Mounted Ball Valves Model #8009 slip between the flanges of your present piping system with a minimum of down time. These valves which have the largest turbulence free port openings of any ball valves can handle corrosives and slurries with equal ease. The positive slotted key drive in the ball eliminates ball wear and ball wobble, permits equal flow in either direction. You get the best features of a globe, gate and plug valve in every Fullport Compression-Mounted Ball Valve —at one low price. The Teflon seats, the extra deep stuffing box and the exclusive "V" ring packing which eliminates troublesome "O" rings are Fullport extras for extra valve service and extra long life. The stem packing, if it should ever be required, can be replaced while the valve is in operation.

Fullport Compression-Mounted Ball Valves are immediately available in stainless steel in sizes ¼" through 6". They test to 1000 psi cold non shock service and 300 psi at 400° F. Through bolts for compression mounting are supplied with each of these valves.

For more information about this and other Cooper Alloy corrosion resistant ball valves write for catalog #BVFA.

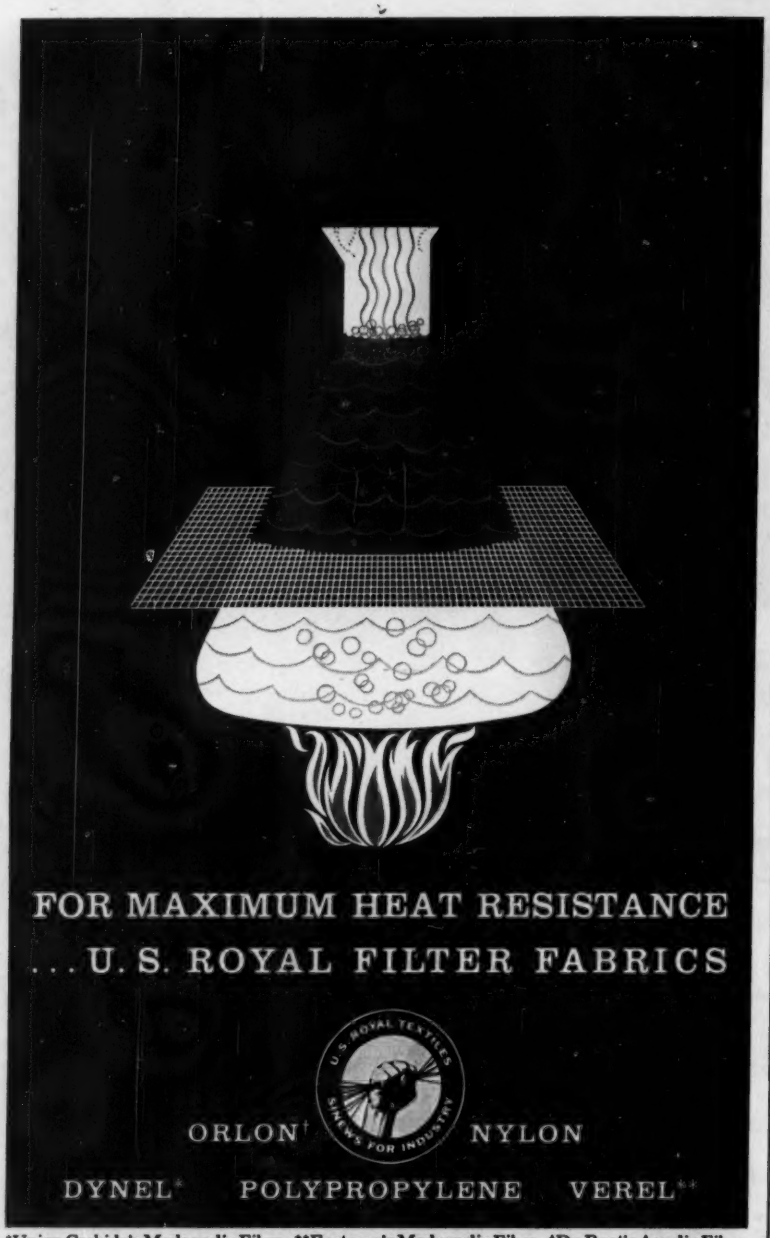
Fullport Stainless Steel Flanged Ball Valve, MSS and ASA face to face dimensions, #8002, ½" through 2", 150 PSI @ 400°F. service.

Fullport Stainless Steel Screwed Ends Ball Valve #8001, ½" through 2", 1000 PSI cold non shock 300 # @ 400°F. service.

Stainless Steel Sanitary Ball Valve #8207, 1" through 2", 150 # @ 400°F. service.

COOPER ALLOY

Corporation • Hillside, New Jersey



*Union Carbide's Modacrylic Fiber **Eastman's Modacrylic Fiber †Du Pont's Acrylic Fiber

Filter fabrics by U. S. Rubber, engineered to exacting service requirements, provide more than maximum resistance to heat. They offer utmost chemical resistance, high abrasion resistance, efficient cake retention-and-discharge properties. Write, wire or phone your specific requirements to Industrial Textiles Department at any of the following sales offices:

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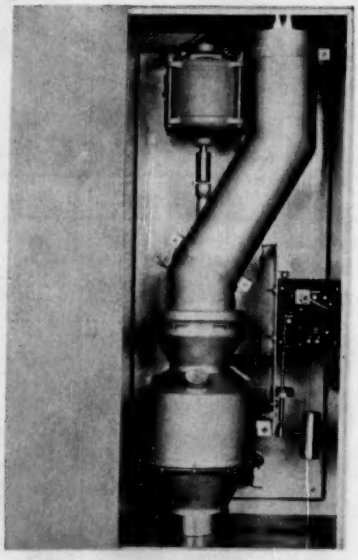
102 N. Brand Blvd.	P.O. Box 461	1230 Ave. of the Americas
CHapman 5-5961	SKyline 4-3116	CIrcle 7-5000

Textile Division
United States Rubber

A photocell detector circuit then becomes unbalanced, and a definite signal results which, when amplified, drives a motor that turns a beam deflector until the light falling on the two cells is again equalized. The amount that the deflector is turned is directly proportional to the difference in refractive indexes between the original sample and any later sample. — **Waters Associates, Framingham, Mass.** **241A**



Solids flow-meter

Impact device provides continuous dry-bulk measurement.

A new device called the IPI Dry-Flow Meter accurately weighs and meters a wide range of dry-flowing materials without interrupting flow, according to the manufacturer. Accuracy on flowing stream of solids is claimed to be ±1%.

Meter operates on an impact principle, translating unit weight of stream flow into electrical current via a transducer. Optional instruments can give direct readings from local or remote stations, make permanent record of flows, or totalize readings for any time period. Automated control is also

ONE pump becomes MANY . . . saving you pump dollars . . . giving you a wide range of clear water, non-clog and other liquid-handling modifications . . . when you standardize your pumping operations with Fairbanks, Morse ADAPT-*ABLE* pumps.

F-M ADAPT-*ABLES* consist of a pump frame and simple adapter to which can be attached a wide variety of F-M hydraulic ends with enclosed, semi-open or non-clog impellers. Conversion is easy . . . inexpensive, too.

F-M ADAPT-*ABLES are "NEMA-Matched"*: pump mounting dimensions are standardized with similar dimensions of Nema-driving motors. Gone is the need for make-shift height-adjusting blocks and odd-bore couplings!

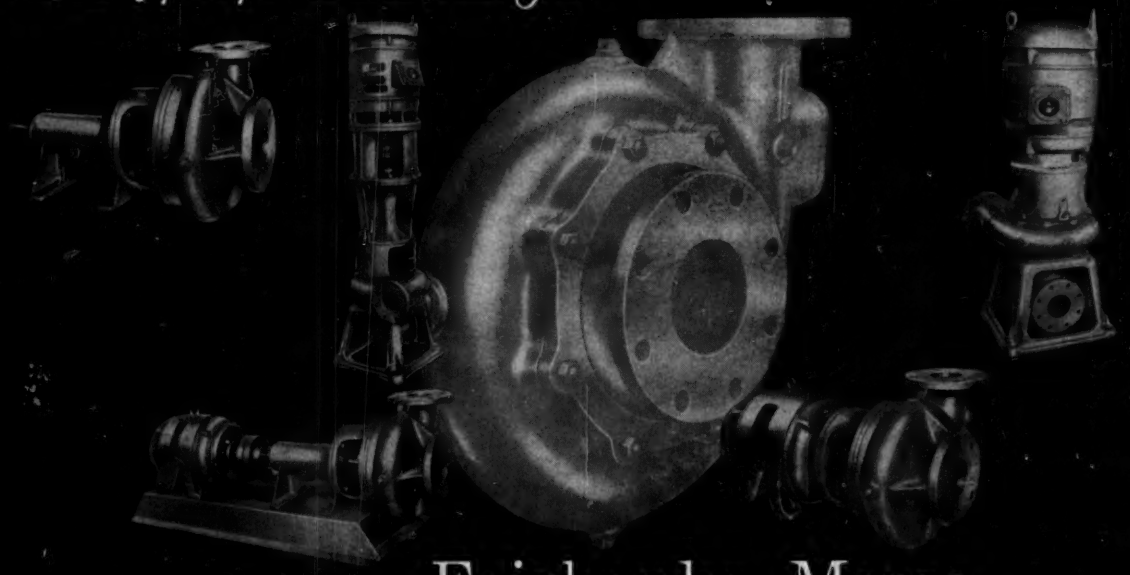
The ADAPT-*ABLE* design means that the most economical frame size may be selected to match the motor horsepower requirements of the pumping job.

And there are other advantages: choice of mechanical seals or conventional stuffing boxes with easy field change-over from one to the other . . . interchangeable bearings for pumps and motors. For special liquid handling problems, hydraulic ends can be specially alloyed to fit the needs: we've been solving such problems for generations.

Regardless of *what* liquids you pump . . . or *where* . . . Fairbanks, Morse builds pumps and *matching* power units for *your* use . . . in a greater range of sizes, types and capacities than *anyone, anywhere*. Start SAVING pump and motor dollars by putting F-M's vast hydraulic experience to work in your plants, process lines and products . . . now!

"nema-matched" *adapt-ables*

. . . a lot of pumps in ONE package!



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THE PROUDEST NAME IN PUMPS

Pump and Hydraulic Division • Kansas City, Kansas

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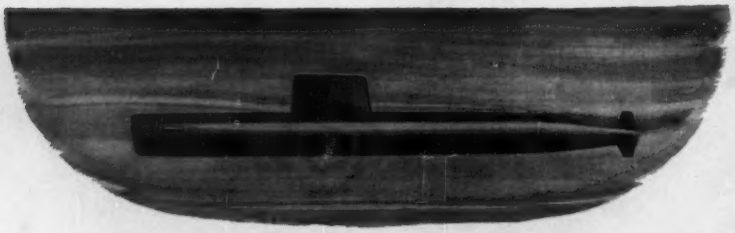
PERFORMANCE RELIABILITY!

That's why new UNITED "720" JETS



and U.S. NUCLEAR SUBS use

CHEMTROL PLASTIC BALL VALVES

Because equipment reliability is absolutely essential in their unique environments, U. S. nuclear powered submarines as well as the new United 720 jet transports are equipped with Chemtrol plastic ball valves. Only after conducting exhaustive tests among many manufacturers, were Chemtrol valves selected—*proof of genuine product superiority for jobs where failures can't be risked!*

If you have a valve job that only *non-corroding plastic can do,* investigate Chemtrol! Here's the simple, positive way to cut replacement costs and maintenance in operations involving acids, alkalies, many solvents. Available in 5 basic plastic materials, many valve types and an extensive size range.

FEATURES: Quick, ¼ turn shut-off, adjustable seats, full flow characteristics, no direction change to cause turbulence or loss of pressure, no sticking or scaling, non-contaminating. Broad chemical resistance even at elevated temperatures. Union type end connectors, quick disassembly.

YOU GET THE **BEST** WHEN YOU SPECIFY CHEMTROL—

The Leader in plastic valves! Write for catalog. Ask for recommendations.

CHEMTROL

404 West Central • Santa Ana, California

possible. Unit costs less than $1,000 without optional equipment.—**Industrial Processes, Inc., Portland 5, Ore.** **242A**

Electric drum-heater

Flexible unit wraps around any drum from 21½ to 23½ in.

Called Electro-Flex Drum Heater, a new unit speeds removal of viscous materials from steel drums. Held in place with a simple spring, the heater flexes for variations in drum diameter, always fits snugly.

Materials of construction are vulcanized silicone rubber, fiber glass, and cloth and metal screen laminate. Rated at 1,000 w. at 115 v., the unit is factory tested at 1,250 v. dielectric strength. Multiple units are used for higher temperatures. Unit cost: $30.—**Electro-Flex Heat, Inc., Hartford, Conn.** **244A**

Water chiller

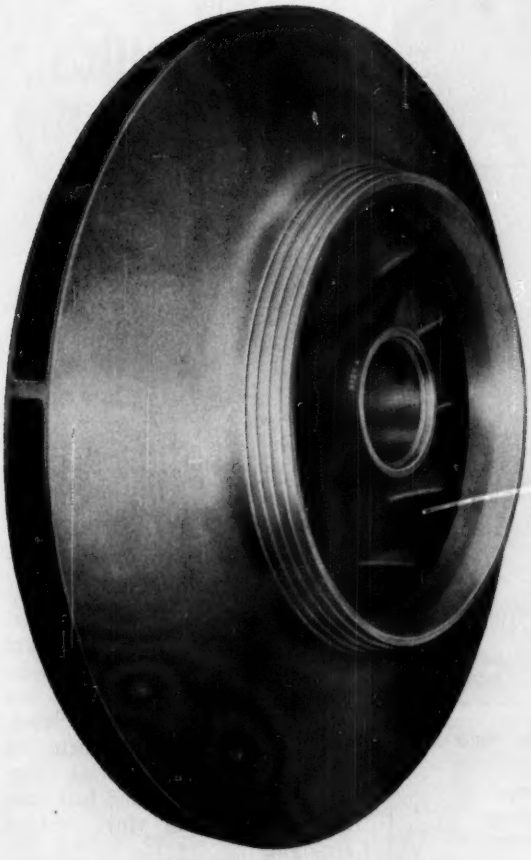
No moving parts or chemical refrigerants are needed.

Water literally chills itself in this vacuum refrigeration unit. Water, exposed to vacuum, boils. Some of its sensible heat supplies the latent heat of vaporization, so

CENTRIFUGAL COMPRESSORS

DE LAVAL welded impeller

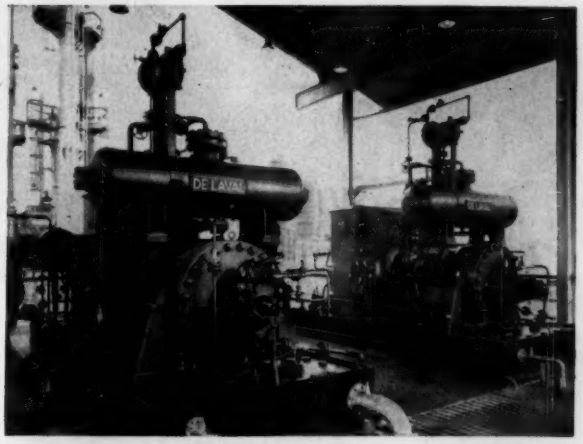
permits higher horsepower, higher tip speeds, greater design flexibility



Now, with a single welded wheel, compressors rated up to 20,000 horsepower at 6500 rpm are giving excellent service.

Produced by a special welding process developed by De Laval, this new welded wheel construction permits higher tip speeds and fewer stages for a given pressure ratio.

Write for more information on this new welded impeller or contact your local De Laval representative.



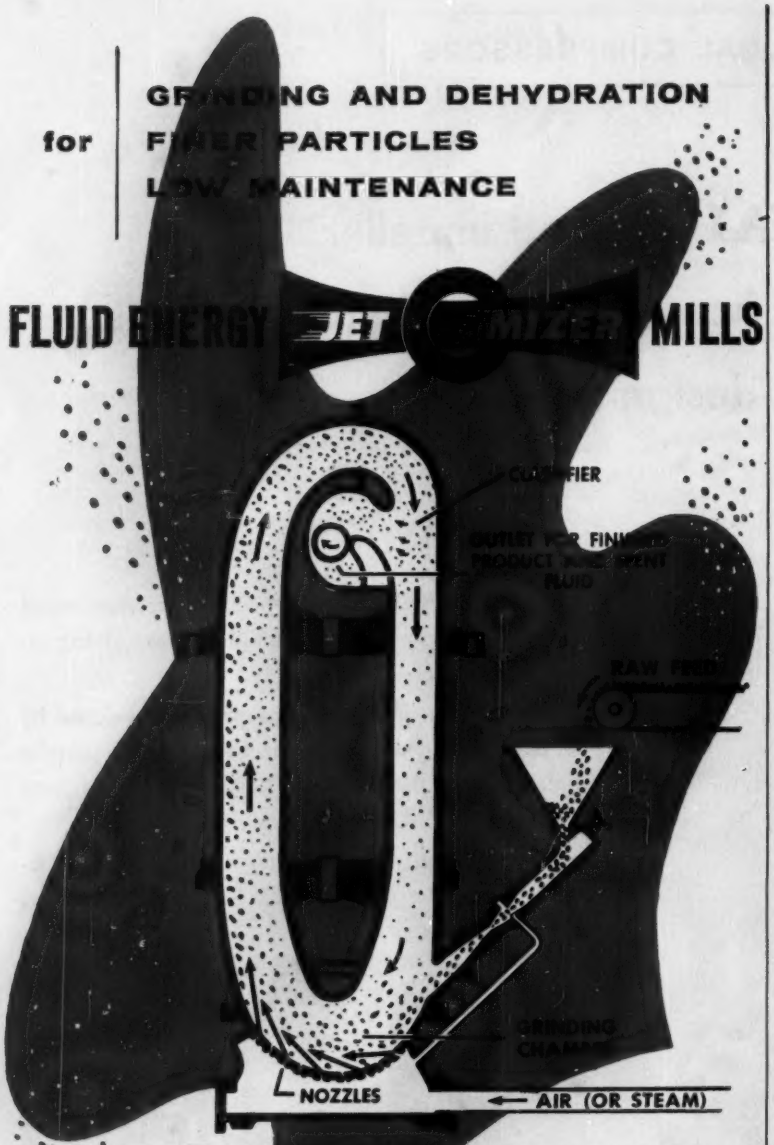
Shown above are two De Laval barrel type compressors—driven by De Laval turbines—in a typical large refinery installation. Units like these are used to pump heavy and light gases and for supplying combustion air for cat crackers.

DE LAVAL STEAM TURBINE COMPANY
NOTTINGHAM WAY, TRENTON 2, N. J.

DL-480 A

for GRINDING AND DEHYDRATION
FINER PARTICLES
LOW MAINTENANCE

FLUID ENERGY JET-O-MIZER MILLS



The Fluid Energy "Jet-O-Mizer" Mill, designed and built by the pioneers in fluid energy fine grinding, does far more than produce fine particles. It controls fineness and product quality with a narrow distribution range and simultaneously with grinding can dehydrate, coat particles, blend and achieve chemical changes.

Jet-O-Mizer Mills are being used all over the world, processing many types of materials in the following industries:

• Abrasive	• Food	• Pigment	• Wax
• Insecticide	• Mineral	• Plastic	• Metal
• Ceramic	• Pharmaceutical	• Carbon	• Chemical

"Jet-O-Mizing" produces FINE PARTICLES ¼ micron average and above PLUS . . . Narrow Particle Distribution • Dry, or Controlled Moisture Content • Continuous Operation • Uniformity of End Product • Other Operations with Grinding • No Attritional Heat — No Moving Parts • Low Operating Costs • Low Maintenance

Send for complete information on Fluid Energy's "Jet-O-Mizer" Mills, "Jet-O-Clone" Dust Collectors, and TESTING AND CUSTOM GRINDING services.

FLUID ENERGY PROCESSING & EQUIPMENT COMPANY
Richmond & Norris Streets, Philadelphia 25, Pa. • Phone: Regent 9-7728
(Formerly known as the Wheeler-Stephanoff Mill)

its temperature drops. Liquid and vapor are separated to obtain chilled water. Degree of vacuum determines the final temperature.

Power input to the device, called Chill-Vactor, is provided by steam, which entrains water vapor from the chill tank to not only separate the vapor from the cold water but also to create a partial vacuum. Most economical unit has a barometric condenser for the mixed steam and water vapor. It operates for long periods on hard water without requiring cleaning. — **Croll-Reynolds Co., Inc., Westfield, N. J.** 244B

All-vinyl fan

Belt-driven unit has strong resistance to corrosive vapors.

Want to handle corrosive vapors with a fan? This new solid vinyl tube-axial unit is made so that all parts in contact with the vapor stream are corrosion proof. Entire fan assembly—including mounting flanges, bearing support, motor support and belt tube is made of solid vinyl, welded air-tight.

Propellers are either polyvinyl-chloride coated or stainless steel. The bearing assembly has a stainless shaft with a special guard to keep corrosive condensate out of the bearings.

Fan also comes with steel drums

(More New Equipment on p. 249)

CUT FUEL BILLS 20% WITH A LJUNGSTROM® AIR PREHEATER

The world's largest fluid catalytic cracker at Esso's Bayway Refinery is equipped with a new Ljungstrom Air Preheater. This picture shows the half-ton cold-end elements being installed in the Ljungstrom rotor.

Your biggest refinery operating expense is the money you burn: fuel costs. You can chop fuel bills ⅓ with a Ljungstrom Air Preheater, and here's how:

Your fuel bill drops about 1% for every 45-50°F you raise the temperature of combustion air. Ljungstroms now in service raise the air temperature 1000°F or more – and the rest is simple arithmetic. With a Ljungstrom, four barrels of fuel do the work of five. On fuel savings alone, one eastern refinery came up with net savings of $67,800 in the first year they used a Ljungstrom.

SAME FUEL, MORE HEAT. Ljungstrom economy is flexible economy. If total throughput is more important to you than fuel savings, a Ljungstrom can help boost the capacity of a pipe still at least 10% a day, without any increase in fuel consumption.

THESE ARE FACTS backed up by 25 years of Ljungstrom performance in refineries all over the world. But they're not the only facts. To find out about Ljungstrom's low-cost maintenance, easy inspection, in-service cleanability, space-saving compactness, call or write The Air Preheater Corporation for a free copy of a brochure called "The Ljungstrom Air Preheater for Process Equipment."

THE AIR PREHEATER CORPORATION

60 East 42nd Street, New York 17, N. Y.

Wrap up high temperature laboratory heating problems fast with new CAL-CORD*

Here's news from Glas-Col . . . a new, flexible cord developed especially for high temperature laboratory heating applications. It's easy to use . . . as flexible as an appliance cord . . . and delivers uniform temperatures. Cal-Cord comes complete with cord and plug. There are no troublesome loose terminals on the ends.

TWO SIZES—400°C and 600°C

Medium "Cal-Cord"—400°C Specifications

Catalog No.	Length	Wattage	Price
C-C 2	2-ft.	80W, 115V	$ 6.50
C-C 3	3-ft.	120W, 115V	9.00
C-C 4	4-ft.	160W, 115V	11.00
C-C 6	6-ft.	240W, 115V	15.00

Made of glass fabric materials. Can be furnished for 220V operation.

Super "Cal-Cord"—600°C Specifications

Catalog No.	Length	Wattage	Price
SC-C 2	2-ft.	200W, 115V	$ 8.00
SC-C 3	3-ft.	300W, 115V	13.75
SC-C 5	5-ft.	500W, 115V	18.00

Made of quartz fabric materials. Can be furnished for 220V operation.

CAL-CORD TEMPERATURE CONTROL

This Thermolyne Stepless Type 800 temperature controller, recently developed, is ideally suited for use with "Cal-Cords." It's a 115V unit. Maximum amps: 13. Watts: 1500. Price $15.75.

*Patent Pending

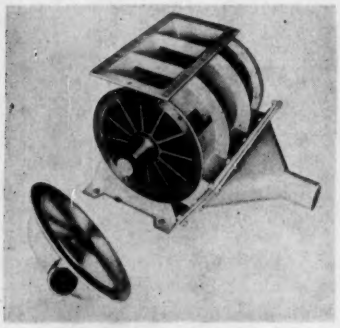
Write for information on "Cal-Cord" today!

GLAS-COL Cal-Cords

Dept. CR, 711 Hulman St. Terre Haute, Indiana

World's largest manufacturer of heating mantles for laboratory, pilot plant, and chemical process heating applications.

coated with either welded sheet vinyl or sprayed polyvinyl chloride. Sized from 16 to 36 in., delivers up to 25,000 cfm.—**Robbins & Myers, Inc., Springfield, Ohio.** 246A



Solids feeder

Blanket of air keeps product away from end bearings.

Feed to pneumatic conveying systems never gets near bearings in a new high-pressure feeder. High-pressure filtered air enters hollow bells on each end of the feeder pockets near the product discharge point. The air sweeps the pockets clean into the discharge line without letting the solids get back to the bearings.

To boost volumetric efficiency, a special inlet configuration mixes the air with the product.—**The Day Co., Minneapolis.** 249A

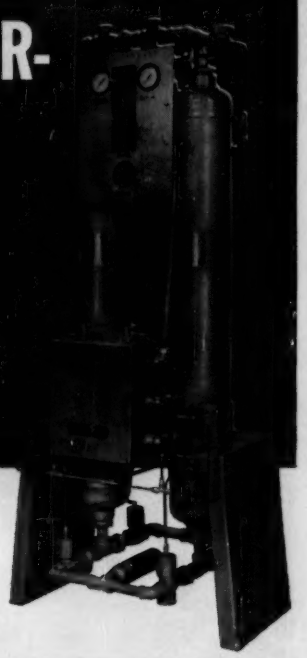
Vapor condenser

Single-unit capacity ranges up to 30 million Btu./hr.

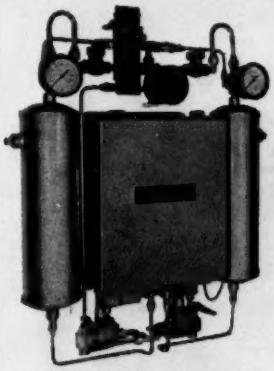
Operating on the evaporative cooling principle, a new high-capacity vapor condenser can reject up to 30 million Btu./hr. In cooling, water is sprayed on the tubes through which the vapor passes. Simultaneously, air is blown over them. The heat given off by the condensing vapor is transferred, via evaporating water, to the air stream and rejected to the atmosphere.

LOW COST, DEPENDABLE INSTRUMENT AIR-

TRINITY Heat-Les



Increase dependability and accuracy of measurement and control in your system by specifying a dependable Trinity Heat-Les Dryer. These amazing dryers, operating on a principle so simple, yet so efficient, are establishing unparalleled operating records in over a thousand installations.

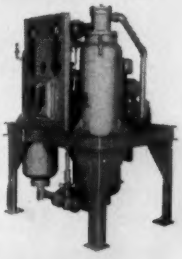


Trinity Heat-Les Dryers are available in standard models ranging from 2 SCFM to 5000 SCFM. Units up to 200 SCFM are available from stock.

★ Low initial cost
★ Completely eliminates costly electric or steam heaters
★ No increase in effluent gas temperature
★ Low installation costs
★ Low operating and maintenance costs
★ Built-in safety system provides dry air for extended period after power failure.

ALSO HEAT-REACTIVATED DRYERS

Trinity also offers a complete range of capacities in heat-reactivated type dryers of an advanced design, offering the greatest economies and performance for this type dryer... WRITE FOR COMPLETE TRINITY DRYER AND ACCESSORY TECHNICAL MANUALS...



TRINITY World leader in dry gas/air systems

Heat-Les Dryers • Heat-reactivated Dryers
Thermocouples and Thermowells

TRINITY EQUIPMENT CORPORATION, CORTLAND, NEW YORK

Keep your
crews busy
all year 'round

with **CARBO ZINC 11***

the all-weather maintenance coating

Most maintenance paints cannot be applied below 40° F. Not so with Carbo Zinc 11 . . . *the only protective coating that can be applied outdoors in cold weather.* Paint *anytime*, 12 months of the year, indoors or out . . . keeping a *smaller* crew busy full time. You still get protection far superior to standard maintenance paints.

- a zinc-filled inorganic protective coating
- water insoluble 20 minutes after applying
- fast drying, long-lasting galvanic protection for steel
- apply in humidity up to 95%, temperatures from –20° F. to 150° F.
- excellent resistance to water, coastal environment, brine, humidity, solvents

Use Carbo Zinc 11 without topcoat, or as primer with vinyl, Hypalon, epoxy, or inorganic topcoat. Resists undercutting and subfilm corrosion. Low material, application and maintenance costs.

Write for information, technical data, uses and samples. Also, see our catalog in CEC, pages 911-914.

*Patent applied for

Sales engineers in principal cities. Consult your telephone directory.

carboline COMPANY

32-D Hanley Industrial Ct. St. Louis 17, Mo.

MAINTENANCE COATINGS WITH EXPERIENCE

NEW EQUIPMENT . . .

Noncondensibles in the vapor are slightly subcooled and separated from the condensate by steam ejector or vacuum pump. Capacity of the unit is regulated by dampers that automatically vary input air rate in proportion to the load, removing heat at the rate of input and controlling temperature closely.—**Niagara Blower Co., New York 17.** **249B**

Computer roundup

Three makers bring out new models with varying features.

The PB-250, combining a large, expandable memory and a command structure with computing speed in the microsecond range, is said by its manufacturer to possess features previously available only in higher-priced units. It is a serial, binary, single-address computer with an internally stored program.

Memory may be expanded from 1,808 words to 15,888 words internally, each word consisting of 21 bits plus sign, and the PB-250 can be programmed to check its own operation and also to monitor the operations of related equipment. Cost of basic computer: $30,000.—**Packard Bell Electronics, Los Angeles.** **250A**

Another new computer is the GE-225. It can simultaneously handle eight different types of peripheral devices, such as magnetic and punched-paper tapes, controllers, high-speed printers, card readers and mass-storage memories. It can also be used with special input-output devices for measuring and controlling process variables.

Incorporating a new programming technique, the GE-225 automatically translates English words and symbols into machine language, thus requiring programmers with little or no training in the language of modern computers. Cost: $125,000 to $400,000, depending on peripheral equipment.—**General Electric Co., Computer Dept., Phoenix.** **250B**

Marlo liquid/gas heat exchangers

are Manufactured to Your Exact Requirements

These quality-constructed units can be supplied in any alloy, any size, for any application.

SPECIFICATIONS ON THIS UNIT

Application: solvent recovery
Surface ratio: 19 to 1
Material:
- **Casing**: Stainless steel 304, 3/16" thick
- **Coil frame**: Everdur, 0.129" thick
- **Fins**: Copper, 0.012" thick
- **Tubing**: Copper, 5/8" O.D., 0.049" wall

Test pressure — coil: 500 psig
Test pressure — casing: 30 psig

GENERAL DESCRIPTION:

Overall dimensions: 94" x 31" x 52"
Weight: 3400 lb
Tube spacing: 1½" staggered centers
Fin spacing: 8 per inch
Face area: 20.9 sq. ft.
Inside surface: 202 sq. ft.
Outside surface: 3810 sq. ft.

Write or phone for additional information for your application.

MARLO coil co.

ST. LOUIS 11, MISSOURI

Quality Air Conditioning and Heat Transfer Equipment Since 1925

What makes them packless?

Corrosive liquids, hazardous gases, steam under pressure—if stem leakage into or out of a system is a problem, Robertshaw packless valves give *positive* leakproof protection.

The heart of each valve is the famous Sylphon® Bellows—specially engineered for the purpose. There are no "stock" bellows at Robertshaw.

Handling industry's toughest jobs, Robertshaw packless valves today feature bellows of brass, phosphor bronze, monel, or stainless steel . . . depending on various conditions of temperature, pressure or atmosphere involved. Valve body and other components also available in a variety of metals, depending on application.

FREE—our highly informative catalog showing the wide range of Robertshaw packless valves. Ask for Catalog SC-F.

Fulton Sylphon Division, Robertshaw-Fulton Controls Co., Knoxville 1, Tennessee.

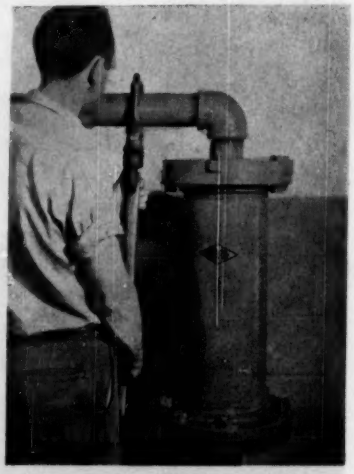
Robertshaw

MR. CONTROLS

NEW EQUIPMENT . . .

Third of the new trio is the Honeywell 290, a digital computer that is the heart of a completely integrated computer-control system. The 290 uses both binary and decimal arithmetic, performs 8,000 additions or subtractions, 1,250 multiplications or 400 square root extractions per second, including memory access time.

Other features include a single-address, 18-bit word length (6 for operation code, 12 for address) vocabulary containing 63 single-address instructions and many no-address instructions, core and drum memory, and random selection of inputs and outputs. Cost has not been revealed.—**Minneapolis-Honeywell Regulator Co., Philadelphia.** 250C



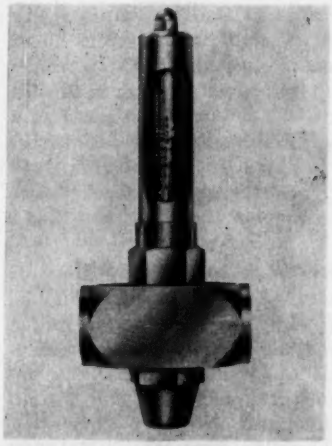
Gas/liquid classifier

Unit lets liquid flow, prevents passage of gas.

A new flow classifier remains open for full liquid flow with negligible pressure drop, but closes automatically under pressure as soon as the line is emptied of fluid.

Automatic nature of the device prevents inadvertent pressure blowback of air or gas through process fluid, makes it possible to handle acids and volatile liquids more safely. It comes in 2-, 3- and 4-in. sizes, must be placed on a ver-

tical line.—**Prenco Mfg. Co., Royal Oak, Mich.** 252A



Armored purge meter

Unit withstands 1,500 psi., 400 F.; handles gas and liquid.

A new armored purge meter gives stable indicating performance even at low gas pressure, according to the manufacturer. Part of an entire new line, it works equally well on gas or liquid, gives quick response since the magnetic indicator travels on the inside surface of a precision-bore scale tube.

Calibrated in both water (gph.) and percentage scales, the tube may be rotated from one scale to the other. An attached factor tag gives conversion figures at a glance.

Capacities range from 1.6 to 100 gph. liquid and 7.5 to 420 scfh. air. Piping connections are all ¼-in.—**Wallace & Tiernan, Inc., Belleville, N. J.** 253A

Briefs

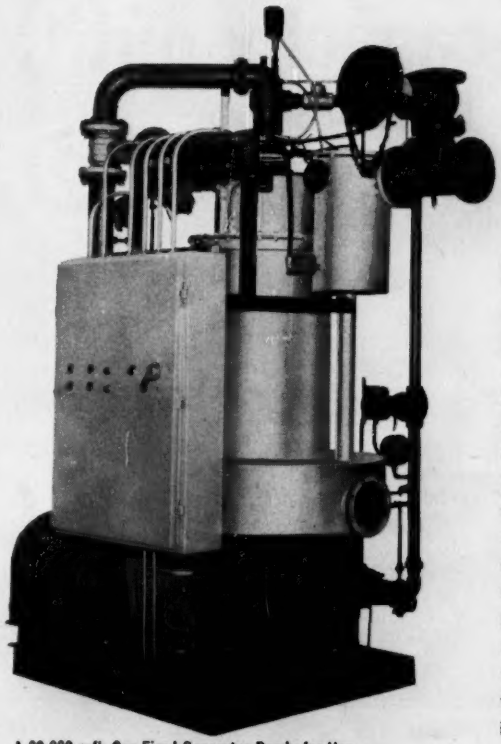
Split packing-gland provides pressure seal on smaller diameter capillary tube after larger diameter bulb thermometer passes

THERMAL

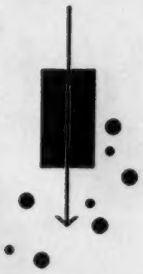
INERT GAS GENERATORS

Using the Sub-X Combustion Process

THERMAL utilizes unique principles of design to provide refineries, chemical processors, metallurgical plants, and other industrial users with a source of inert or purge gases that is compact in size and provides high outputs for low initial cost. Standard outputs range from 2,000 scfh to 60,000 scfh.



A 30,000 scfh Gas Fired Generator Ready for Use



SUBMERGED EXHAUST OF COMBUSTION PRODUCTS makes feasible the use of low-cost or contaminated water as coolant without concern over fouling of surfaces. The tank of water through which the gases pass provides an unusual degree of safety. Heat transfer efficiency is extremely high.

REFRACTORY IS ELIMINATED and maintenance costs reduced through the use of the high heat release THERMAL burner which can be fired with gas, distillate oil, or dual fuel. Units are supplied as a complete package and include all control and safety equipment.

For detailed information write for Bulletin #114-B

THERMAL

Thermal Research & Engineering Corp.

CONSHOHOCKEN • PENNSYLVANIA

REPRESENTATIVES IN PRINCIPAL CITIES

Other Thermal Products & Services:

Gas, Oil & Combination Burners
Heat Exchangers
Air Heaters
Submerged Combustion
Combustion & Heat Transfer Equipment

EQUIPMENT TODAY FOR THE CHALLENGE OF TOMORROW

GARDNER-DENVER

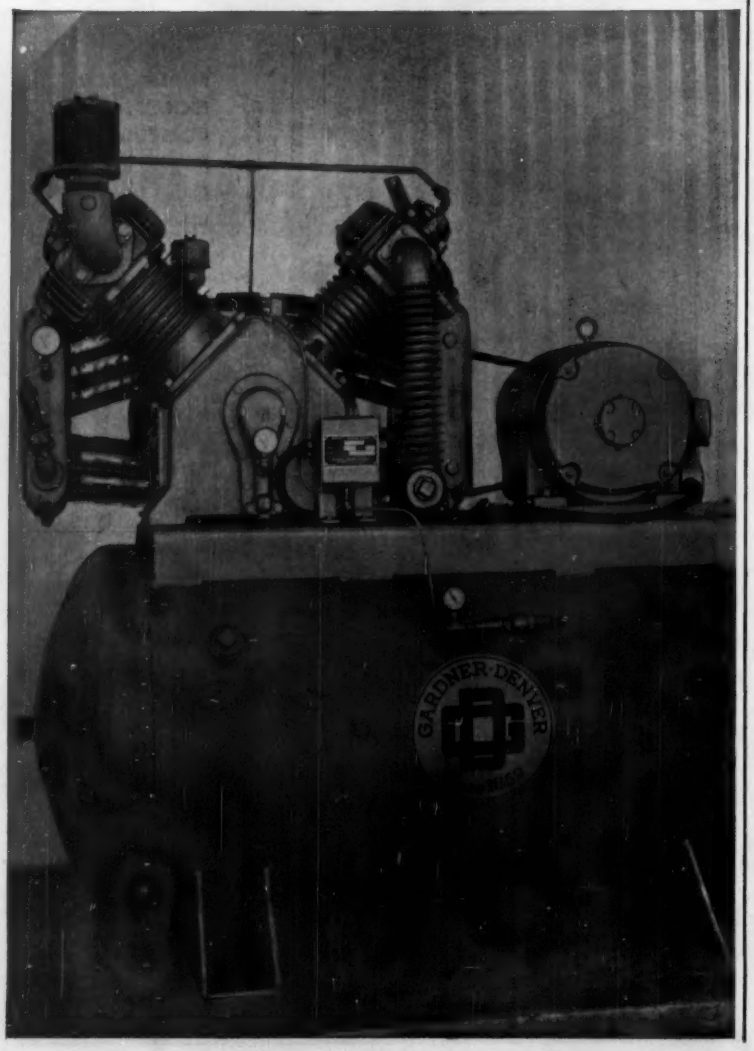
Since 1859

GARDNER DENVER

Here's one of the highest-capacity tank-mounted compressor outfits available—to provide low-cost air without adding a more expensive type of installation. It's the Gardner-Denver ADL—a two-stage, air-cooled, 20 hp, two-cylinder unit. In continuous service, it has a piston displacement of 100 cfm at 870 rpm. Discharge pressure up to 125 psi, or as high as 250 psi on intermittent service. Compressor alone also available. For information, write Gardner-Denver Company, Quincy, Illinois.

High-capacity outfit

for low-cost air



through the gland body. Good at −300 to 1850 F. at pressures to 7,500 psi.—**Conax Corp., Buffalo, N. Y.** 253B

Rotary pilot dryer with 15-in. dia. chamber (8 ft. long) can test-dry material under a variety of flows, temperatures and flight arrangements. It uses either counter or parallel flow, may also serve as a rotary kiln when special refractory lining is applied for such service. — **Standard Steel Corp., Los Angeles.** 254A

Sensi-touch, a protective glove, is said to be super-sensitive, pliable, yet very tough. Made of milled neoprene, new glove resists chemicals and heat, is especially designed for handling fine instruments and parts. — **Charleston Rubber Co., Charleston, S. C.** 254B

Inclined-vertical manometer is fabricated from solid block of clear acrylic plastic to make it virtually unbreakable. Accurate readings are promoted by polished chromium fixed-scales. Designed for use with pitot tubes and in flow measurement, new unit is available in single and double column styles, stationary or portable, in ranges up to 23 in. of water.—**F. W. Dyer Mfg. Co., Michigan City, Ind.** 254C

Seculate, a hard coating, prevents condensation on pipes and other surfaces, acts as insulator and also absorbs small amounts of moisture that it later releases when the humidity drops. Product brushes or sprays on metal or building material to form off-white film that does not drip moisture.—**Chemical Concentrates, Fort Washington, Pa.** 254D

Pipeline pig, market-ready at 400 lb., has a steel body with rubber sphere on one end, two rubber cups on the other. Sphere is inflated to pipeline size before the unit is inserted. Instead of acting like a conventional line cleaner, unit serves as a highly efficient batch separator, reducing inter-

face mixing by 70%.—**Gulf Research & Development Co., Pittsburgh.** 254E

Safety goggle, with soft flexible frame, has all-plastic vents louvered for dust and splash conditions. Clear or green frame or lens. —**Welsh Mfg. Co., Providence, R. I.** 255A

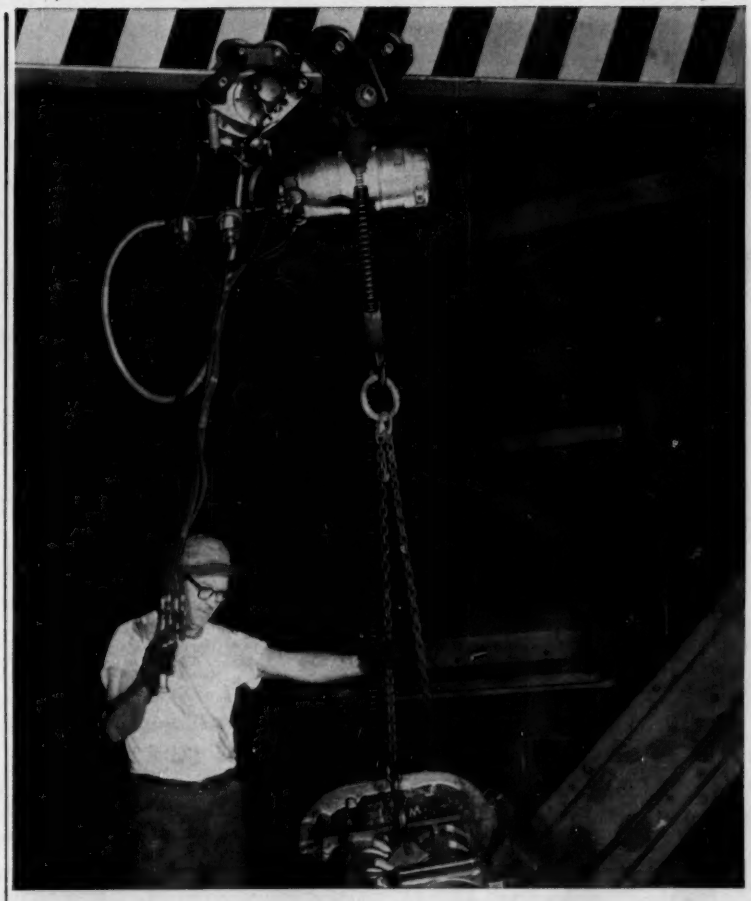
All-metal belt conveyor, with body depth reduced by one-half, is now available in lengths up to 500 ft. Self-tracking feature permits heavy loads to be pushed on or off from the sides without disturbing the belt. Belt widths: 12 to 36 in.—**M-H Standard Corp., Jersey City, N. J.** 255B

Penton sheet, in 48-in. width, can be used to line tanks, vessels and other equipment. The chlorinated polyether sheets can be installed in new or old equipment where resistance to corrosion or abrasion is needed. Welding rods, seams and corner strips are available.—**National Vulcanized Fibre Co., Wilmington, Del.** 255C

Equipment Cost Indexes . . .

	Mar. 1960	June 1960
Industry		
Avg. of all	237.8	238.2
Process Industries		
Cement mfg.	232.4	232.8
Chemical	240.0	240.1
Clay products	225.8	226.2
Glass mfg.	226.6	226.6
Paint mfg.	229.7	229.8
Paper mfg.	231.3	231.3
Petroleum ind.	234.7	234.1
Rubber ind.	237.5	237.6
Process ind. avg.	236.3	236.5
Related Industries		
Elec. power equip.	242.8	242.7
Mining, milling	241.5	241.5
Refrigerating	268.4	268.5
Steam power	224.9	225.0

Compiled quarterly by Marshall and Stevens, Inc. of Ill., Chicago, for 47 different industries. See Chem. Eng., Nov. 1947, pp. 124–6 for method of obtaining index numbers; April 4, 1960, pp. 149-50 for annual averages since 1913.



Team Push-Pull Power...

lift and load faster

Saving time and muscle, a Gardner-Denver "Hoistractor" and air hoist team up to provide economical push-pull power in handling heavy plant loads like this. One man, using only one hand, controls the entire operation.

The Gardner-Denver "Hoistractor" is an air-powered hoist trolley connected to the hoist by a drawbar. Both units ride the same beam. Hoist lifts and lowers . . . "Hoistractor" moves hoist *and* load along the beam.

This unusual combination of Gardner-Denver "Hoistractor" and hoist teams two-way power for faster, cheaper material handling. Write for bulletins.

EQUIPMENT TODAY FOR THE CHALLENGE OF TOMORROW

GARDNER-DENVER

Since 1859

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Gardner-Denver Company, Quincy, Illinois

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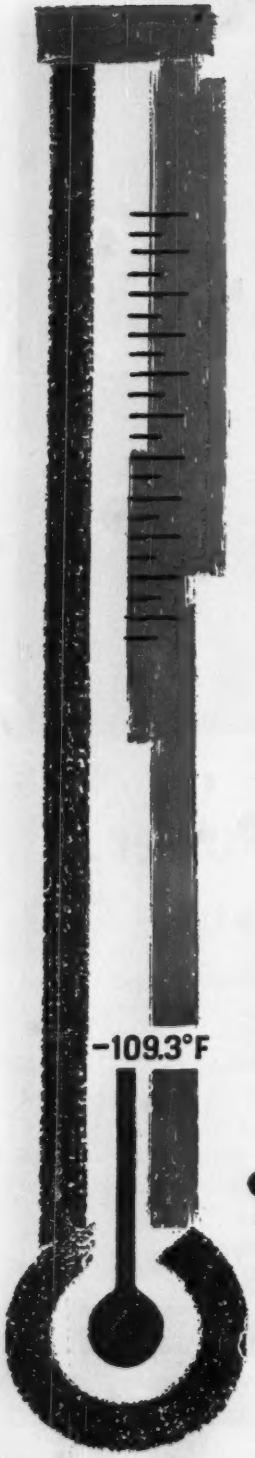

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Technical Bookshelf

All About Engineering

THE STORY OF ENGINEERING. By James Kip Finch. Anchor Books. Doubleday & Co., Inc., New York. 528 pages. $1.45.

Here is an account of the span of engineering, beginning with construction in Egypt's Pyramid Age (circa 3000 B.C.) and running through time, into the '50s in the U.S.

Though lacking an index, this big, soft-cover book is well handled chronologically, with many chapter and subheadings serving as guides.

It should be of interest not only to students or the layman seeking to learn something about the subject, but also as a pleasing refresher course or easily shelved reference book for those professionals who have been through it all before but who might like to get some background on a phase or two in a hurry.

There are twenty-two sections, including a detailed study of engineering in Greece and Rome, a very interesting account of its growth in the Middle Ages and, following development throughout Europe, a report on American engineering.

The book is well illustrated, reads easily. The author is especially aware of the tide of "regular" history simultaneously occurring and he succeeds in presenting this interrelationship to the reader.

About the only fault this reviewer could find, aside from the absence of the index, was the omission of any material on nations east of Asia Minor. It is true that the work is intended only to be a record of "Western" engineering but, in view of its title, a short chapter on the Far East would not have been amiss.

All in all, a great deal of material has been crammed into this very entertaining volume.—HSG

Red-Carpet Treatment

FLUIDIZATION AND FLUID-PARTICLE SYSTEMS. By Frederick A. Zenz and Donald F. Othmer. Reinhold

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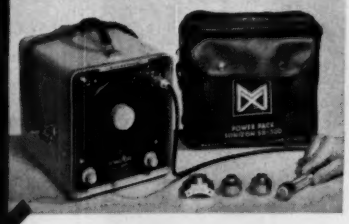

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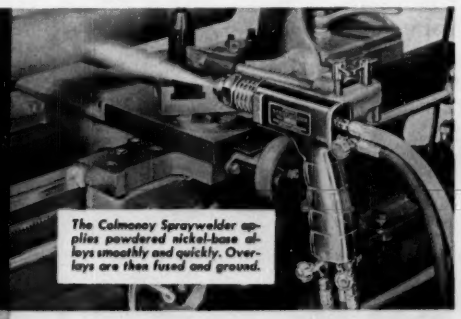

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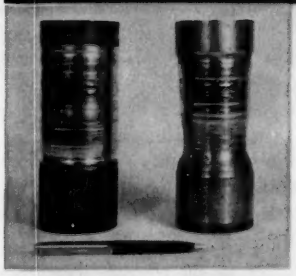

Left: mild steel sleeve with Colmonoy No. 6 overlay after 395 days service. Right: stainless steel (316) sleeve after only 105 days service.

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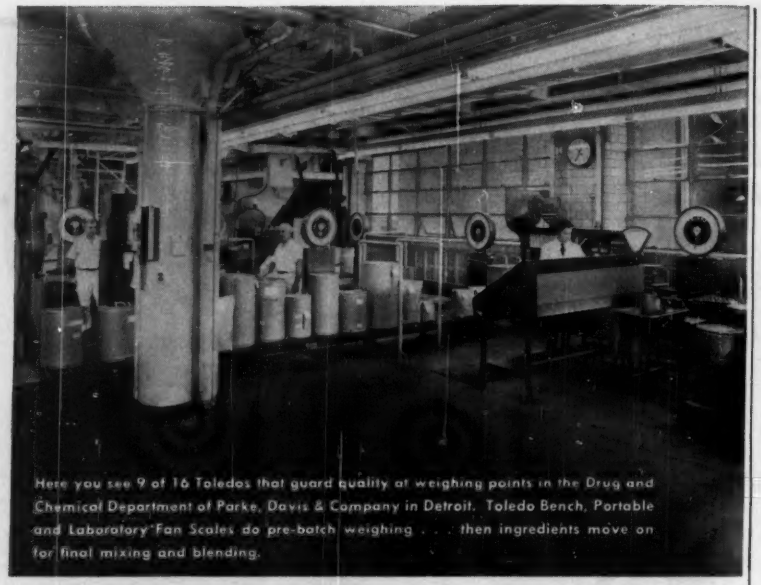

Here you see 9 of 16 Toledos that guard quality at weighing points in the Drug and Chemical Department of Parke, Davis & Company in Detroit. Toledo Bench, Portable and Laboratory Fan Scales do pre-batch weighing . . . then ingredients move on for final mixing and blending.

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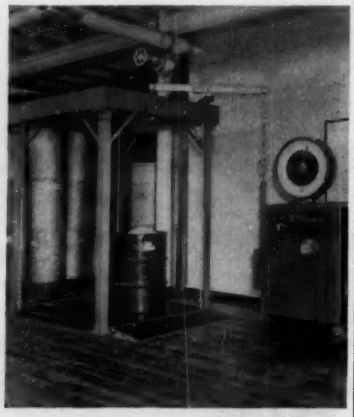

● Toledo Model 2282 Suspended Platform Scale weighs drug materials going into batches in the Crude Drug Milling Section of the Extract Department.

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Headquarters for Weighing Systems

Publishing Corp., New York. 513 pages. $15.

Reviewed by James T. Clancey, Consolidation Coal Co., Pittsburgh, Pa.

Compiling a book dedicated to a comprehensive coverage of fluidization and fluid-particle mechanics is bound to be an ambitious project. Fortunately, the authors (both on the staff of the Polytechnic Institute of Brooklyn) are experts in these fields and prove equal to the challenge.

Much of the published work on these subjects has been assembled and presented in a logical sequence. The first chapter is a very readable and complete history of the development of fluidization. Following chapters deal with rheology of powders and characteristics of bulk solids, flow through fixed beds, flow of single particles, flow through (and within) fluidized beds and, finally, two-phase flow. Individual references to the literature exceed 800.

The most rewarding feature of the book is the attempt of the authors not only to note and pigeonhole each reference in the correct chapter, but to compare data from various sources, discuss differences, and supplement the text with new, unpublished data. The chapters dealing with fluidization and bulk flow of solids receive most of this "red-carpet" treatment. Chapters dealing with two-phase flow are not so similarly blessed.

Typography is excellent, the numerous drawings sharp and readable (although not particularly large) and misprints are rare.

The book is highly recommended, particularly to those working in research or design of fluid-particle systems.

MORE NEW BOOKS

THE CARBOHYDRATES. By S. F. Dyke. Interscience. $4.75.

THERMAL ENGINEERING. By H. L. Solberg, O. C. Cromer & A. R. Spalding. Wiley. $9.50.

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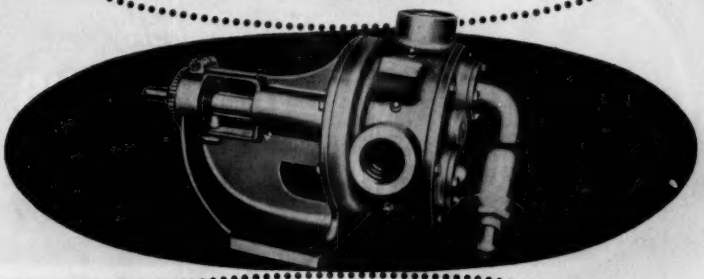

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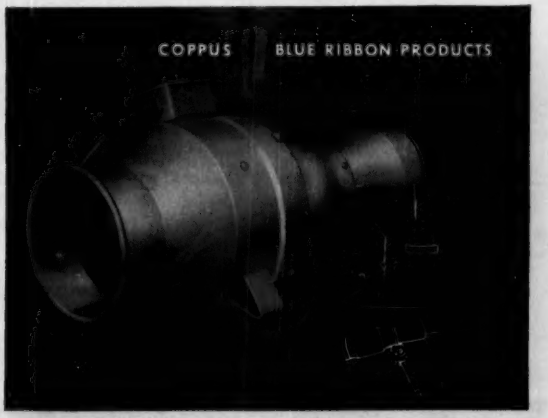

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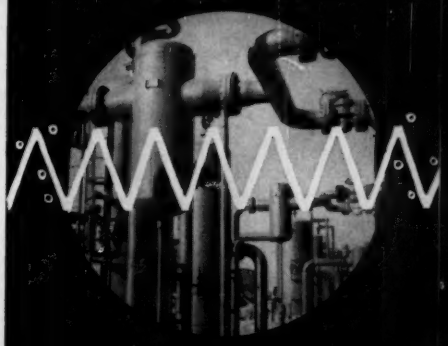

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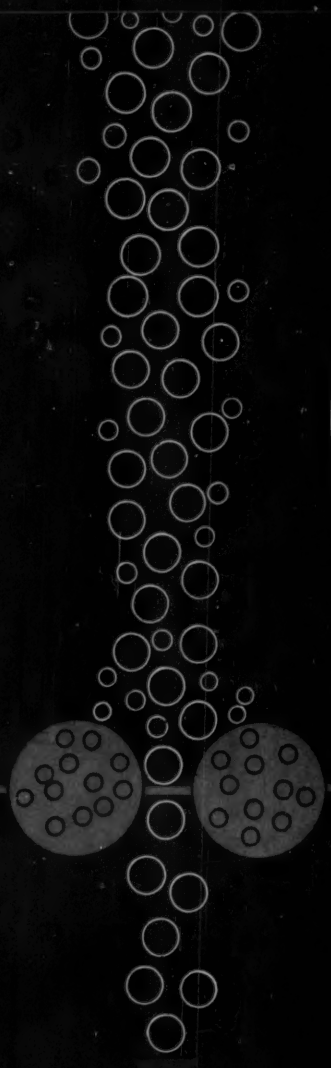

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This is only one of many applications which utilize the high capacity and selectivity of LINDE Molecular Sieves. In fact, Molecular Sieves not only outperform other adsorbents, but do other adsorption jobs never before accomplished. Whether in new installations or as replacement adsorbent in existing units, Molecular Sieves can help you minimize both investment and operating costs. More specifically, here's how they are used. . .

A major petrochemical company has reduced the CO_2 content of its ethylene from 3000 PPM to less than 1PPM. This high purity is achieved in a single-stage process, automatic and non-corrosive, which has proved to be more economical than the alternative four-stage process. Other petrochemical uses include drying of cracked gases, ethylene, hydrogen, liquid propylene, solvents and many other gases and liquids. **Natural gas producers** use Molecular Sieves for drying and sweetening of natural gas, for sweetening of liquid propane and butane, and for drying of adsorber oil. **Petroleum refiners** use them to gain efficiency in drying reformer hydrogen, liquid butane LPG and transformer oil, and for removal of impurities such as CO_2 and mercaptans. **Refrigeration manufacturers** use Molecular Sieves as a desiccant in super-drying refrigerants to eliminate freeze-up and corrosion.

For these and many other adsorbent applications, you can rely on patented LINDE Molecular Sieves to perform more effectively. They are the top quality material of their kind available today, always uniform, with high capacity, high strength, and high bulk density. They are available in regular and special grades to meet your specifications.

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SOME AREAS WHERE MOLECULAR SIEVES IMPROVE ADSORPTION

- Purification of ethylene
- Drying gases, liquids, solvents
- Drying, sweetening natural gas
- Sweetening liquid propane, butane
- Drying jet fuels
- Octane improvement
- As refrigerant desiccant
- Controlled atmosphere purification

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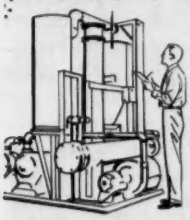
Carl G. Paulson,
Director of Hayes Research and Development Group, Reports...

NEW NITROGEN POTENTIALS

Assume you face the need for high purity nitrogen at a low per-unit cost figure. You want to use it as a heat treating atmosphere . . . or as a "blanket" for hydrocarbons or food products . . . or for any one of a number of industrial applications. How can you bring this safe, inert gas out of the lab and into general use without inflating your costs?

Our R & D group reasoned that a low cost generator was the logical solution and followed up and developed a completely new piece of equipment—the C. I. Hayes "Nitro-Gen." This unique combination of stationary retort and cyclical programmed dryer has cleared the way for production of 99.99% pure inert gas at approximately 20c per thousand cubic feet.



The immediate benefits of low cost nitrogen as a protective heat treating atmosphere were revealed in initial metallurgical applications. For example, test bars of Type C-1141 Carbon Steel were subjected to routine hardening under (1) nitrogen, (2) dissociated ammonia, and (3) endothermic gas atmospheres—each test followed by routine oil quench and tempering. Hardness results from these tests proved identical . . . but a substantial boost in toughness showed up in the bars treated under nitrogen. The nitrogen atmosphere produced 100% greater toughness, according to a transverse break test.

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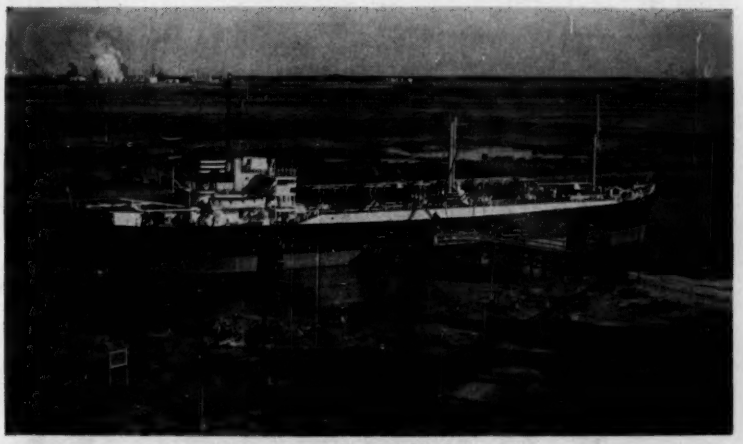
Letters: Pro & Con



"Significant commercial experiment"—the *Methane Pioneer*.

Pro: Cryogenic Aluminum

Sir:

Your series on cryogenic applications of construction materials is a valuable contribution to the study of this subject. It is especially timely in view of the recent success of the *Methane Pioneer* project, which is perhaps the most significant commercial experiment to date in the handling and transportation of liquefied gases.

However, I thought it rather curious that this important project, where aluminum is used so successfully and economically, was not mentioned in the aluminum article (Aug. 8, pp. 133-136) of this series. Instead, it was referred to in the lead paragraph of the article on nickel steel alloys (July 25, pp. 115-118). This might mislead a reader into thinking that 9% nickel steel was the metal used.

Actually, the *Methane Pioneer* uses five aluminum rectangular tanks to hold 35,000 bbl. of liquid methane at –260 F. It has made seven successful trips to England, carrying methane. In addition, the terminal facilities at Lake Charles, La., utilize a 35,000 bbl., land-based, insulated storage tank and piping, all fabricated of aluminum. Terminal facilities in England also use aluminum tankage and piping.

We have available, upon request, extensive data on 5083 and 5086 alloys, the most commonly used aluminum alloys applied to date in the field of cryogenics. This information covers such things as mechanical properties, impact, fatigue, coefficient of expansion and reflectivity of the two alloys at low temperatures in both the parent and welded materials.

D. R. CHEYNEY
Kaiser Aluminum & Chemical Corp.
Oakland, Calif.

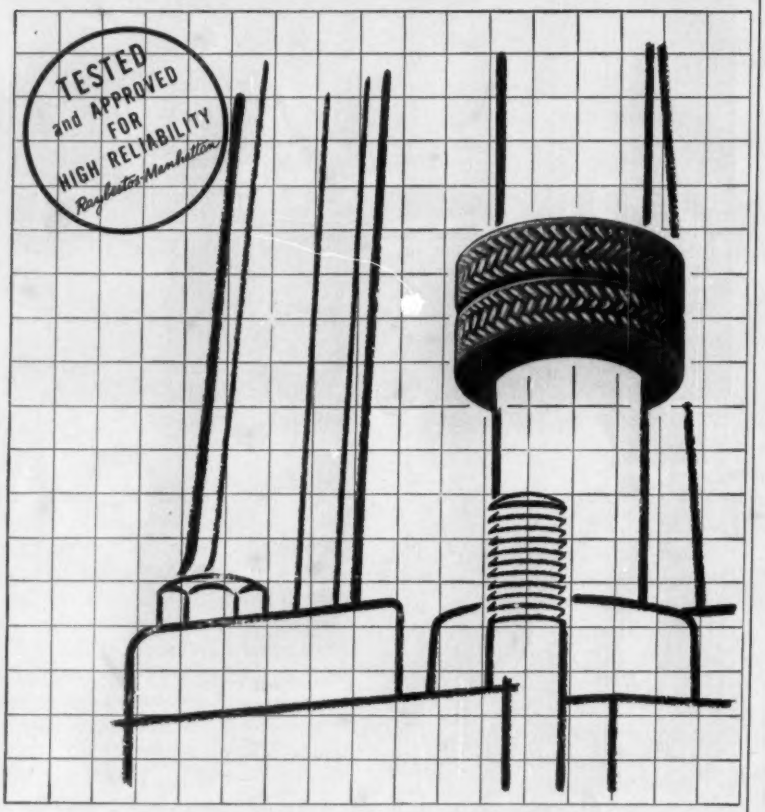
Con: Tables of Symbols

Sir:

I was very much interested in Prof. Coates's "Azeotropic Separations" (May 16, pp. 121–136) and especially in the various corrections reported thereafter in your *Letters* department. I have another correction to offer. In Fig. 9, the arrow showing composition of top product from the first column is erroneously placed; it refers mistakenly to the top product from the third column. Also, since the separation in the third column involves the removal of water, shouldn't you show a stream of water leaving the bottom of this column?

R/M CAPABILITY

takes the guesswork out of high-temperature valve stem packing selection and application



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PRO & CON . . .

This comedy of errors, I believe, stems from a long-time trend which has led to an impossibly (and unnecessarily) complex terminology and very careless and fuzzy writing (and probably careless and fuzzy thinking). I refer to the substitution of symbolism for physical reality. Many leading mathematicians have expressed dismay over this trend within their own profession. I believe that a great many chemical engineers are also getting completely out of touch with reality.

In my opinion, the practice of using a table of nomenclature should be dropped from all chemical engineering literature. Such tables are generally confusing and quite often contain serious errors.

In the case of this article, A and B, the van Laar constants, are adequately identified at least four times in the text of the article. It certainly seems unnecessary to define A and B in a separate table.

The symbol B is also used to refer to the bottoms flow rate, as per the table of nomenclature (p. 128). Compounding the confusion, however, is that in Fig. 12, A and B refer to components in the feed, and in Fig. 9, A is the primary column and B is the separator!

Moreover, in Example 2, I find extensive use of subscripts 1, 2, 5, 6 and 7, obviously referring to plate numbers, yet the nomenclature identifies subscripts 1, 2 and 3 as pure components.

I suggest you discard tables of nomenclature and identify symbols in the text where they are used.

RALPH H. WING
West Virginia Institute of Technology
Montgomery, W. Va.

Sir:

In Prof. Coates's article, there is an error in Eq. (27). The plus sign in the denominator should be a minus sign. Incidentally, another form of this pinch-point equation, namely,

$$x_n = S/(L - VK_n)$$

is much easier to use. It requires only that you know K_n, which in

practice is nearly always known, as on a given tray it is generally necessary first to calculate the temperature rather accurately, in order to establish the mass flows by heat balance.

J. C. NORENBURG
M. W. Kellogg Co.
New York, N. Y.

Pro: Award to Phillips

Sir:

We have had several favorable comments about your excellent article in the June 27 issue (pp. 128-132) on the NSPE Industrial Professional Development Award to Phillips Petroleum Co. We are considering the possibility of circulating reprints of this article to industry generally throughout the country.

We appreciate very much the interest you have shown in this award, as well as in other aspects of NSPE's program.

MILTON F. LUNCH
National Society of Professional Engineers
Washington, D. C.

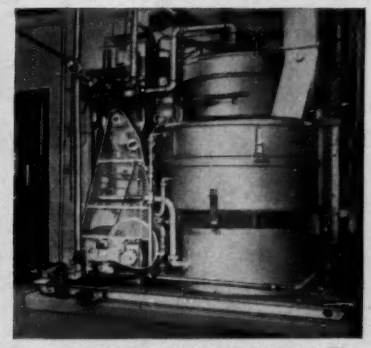
Fire-Retardant Enamel

Sir:

In your *New Chemicals* section for Aug. 8 (p. 80), you stated that "fire-retardant enamel for use on previously painted or primed metal

3 BOILERS IN 1 COMPACT PACKAGE!

FOR ORDINARY STEAM REQUIREMENTS: The cycle-type Modulātic standard unit furnishes 90% dry steam for most ordinary needs such as cooking, heating water, drying, cleaning, etc.



WHERE DRY STEAM IS REQUIRED: The Modulātic may be used with an optional steam separator, for over 99% dry steam for heating, moulding, forges, operation of power equipment, etc.

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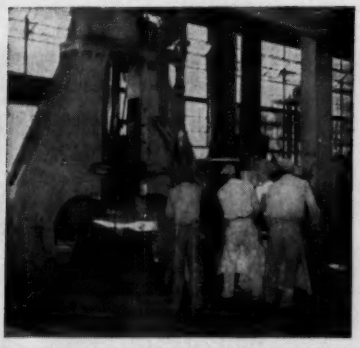
¼ the size and weight of conventional boilers... largest size (150 BHP) uses only 5′ x 8′ space.



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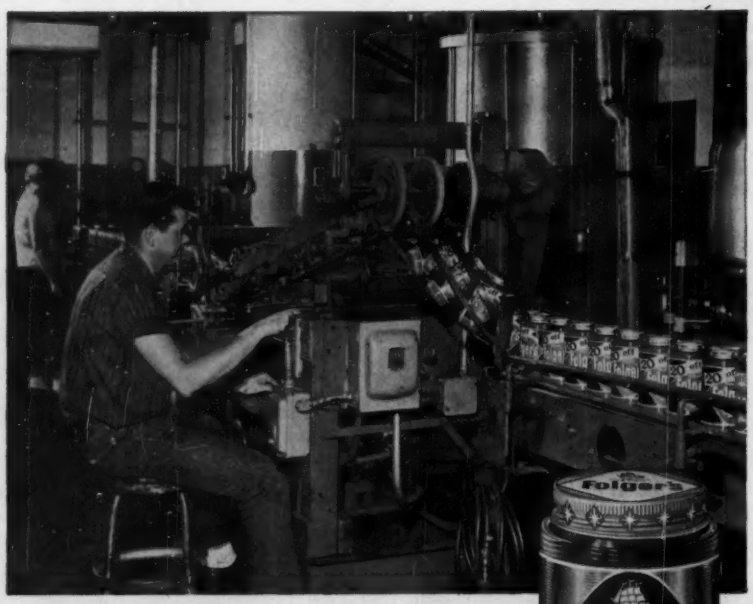
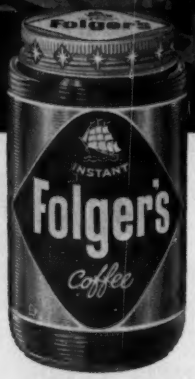


Dry air speeds packaging ...protects quality of instant coffee

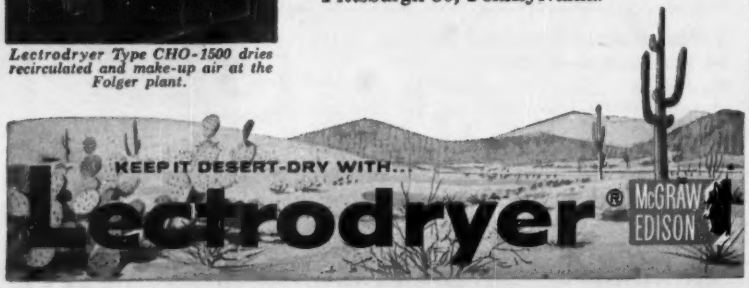


Instant coffee absorbs moisture fast. If this happens before it reaches the coffee cup—say when it's being packed—it can clog up packaging machines, ruin the quality of the coffee. In Houston, where humidity stays high for long stretches, the makers of Folger's coffee solved the problem by installing a Lectrodryer that keeps relative humidity at 25% to 35%.

Controlled dryness by Lectrodryer has been the answer to many problems caused by moisture; gumming up of hygroscopic powders, corrosion of metal, air line freezeups, and contamination of drugs, chemicals, liquids, gases.

Lectrodryer Type CHO-1500 dries recirculated and make-up air at the Folger plant.

For a Guide in Planning your own drying system, write for Lectrodryer's Case History Sheets, which give details on how many of these problems were solved. Tell us where you're having trouble with moisture. Pittsburgh Lectrodryer Division, McGraw-Edison Company, 303 32nd Street, Pittsburgh 30, Pennsylvania.



bulkheads and other interior surfaces is now marketed as HET acid."

Hooker Chemical, which makes HET acid, does not manufacture the enamel itself but supplies HET acid to paint manufacturers for incorporation in their alkyd resin formulations to impart the desirable fire-retardant quality.

T. H. TRIMBLE
Hooker Chemical Corp.
Niagara Falls, N. Y.

Con: Advice to Speakers

Sir:

The article, "Beware of the Expert Speech Makers," in your Aug. 8 issue (pp. 143-144) is likely to raise a good deal of response, possibly along the lines of my own. But I cannot hold back my comments.

Admitting that Mr. Sylvester meant to be humorous in his article, it is still proper to state that his suggestions are absurd. Viewed in the framework of his professional activities, the suggestions are ridiculous. And, we might add, it's highly unlikely that he practices this sort of attitude in the technical publications at Sohio. If he does, he's likely to have a mighty short career!

Admittedly, overdone, trick-loaded technical talks are not to be desired. But Sylvester's five points are patently absurd unless translated into the area of humorous counterbalances to the overdone.

On the other hand, let's compliment him on "How to Sound Like a Manager." This was excellent.

WILLIAM S. PENN, JR.
Stanford Research Institute
Menlo Park, Calif.

Sir:

I was appalled at your article entitled, "Beware of the Expert Speech Makers." Apparently the man who wrote this article is completely unethical; I hope he is not a chemical engineer.

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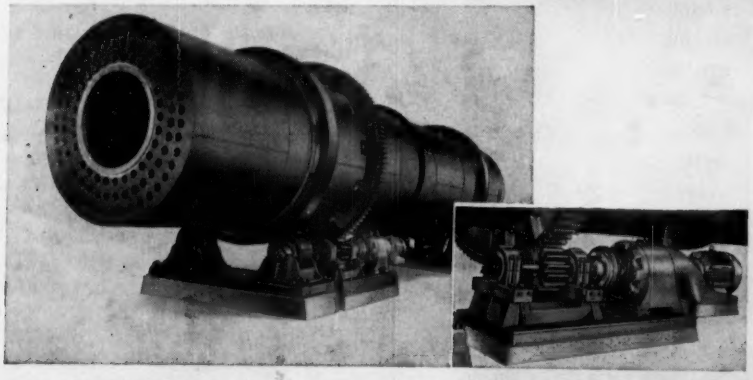

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He equates the function of speechmaking with advancement in the company. This is evidenced by several statements in his article, such as: "Criterion of success for a technical talk is not whether people enjoyed it, but whether certain people approved of it." These people he defines as those who can advance your status in the company or who have a financial relevance to your employer.

This is without a doubt the most unethical statement I have ever seen in a supposedly professional magazine and by a man who is a technical editor. I would like to know if Mr. Sylvester is an engineer so that I might encourage the appropriate organization to take action against this completely unethical person.

GEORGE L. MUELLER
Houston, Tex.

► *Author Sylvester is not an engineer; he is a Ph. D. in English. And he is no longer at Sohio; he is now teaching at Case Institute of Technology.*

In defense of Dr. Sylvester, as well as of ourselves (since we accepted and published this article), we plead guilty only to the crime of exaggeration. Dr. Sylvester's principal point, which we think is well taken, is that a technical talk should be designed primarily to inform, not entertain, the audience.— ED.

Con: Salary Inequities

Sir:

I read with great interest your article, "Top Pay, Starting Pay and Your Pay," in the July 11 issue (pp. 140-144). I found that after 1½ years of field experience I am earning less than most chemical engineers who have just graduated.

I graduated from —— in January 1959 in the top half of my class. After sending out about 100 resumes, I received two offers. Neither offer greatly excited me, but I considered one of them adequate and accepted it. Perhaps the lack of interest in my resume resulted from the fact that I wanted to attend

law school with the eventual objective of working as a patent lawyer.

I am most interested in what my fellow chemical engineers have to say about your article. It certainly upset me.

NAME WITHHELD

Mt. Vernon, N. Y.

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L. R. EEMAN

Port Alberni, B. C.

Pro: Better Writing

Sir:

I greatly enjoyed Mr. Heinmiller's analysis of "How to Write a Good Technical Article" in your May 2 issue (pp. 127-128).

It is the sort of very practical advice that would be useful to a person doing technical writing in any field. On both the federal and state levels within our Bureau, there is a considerable amount of technical writing, and hints on improvement are always helpful.

RUTH L. BARTH

U. S. Department of Labor

Washington, D. C.

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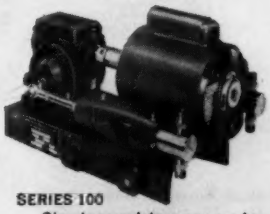

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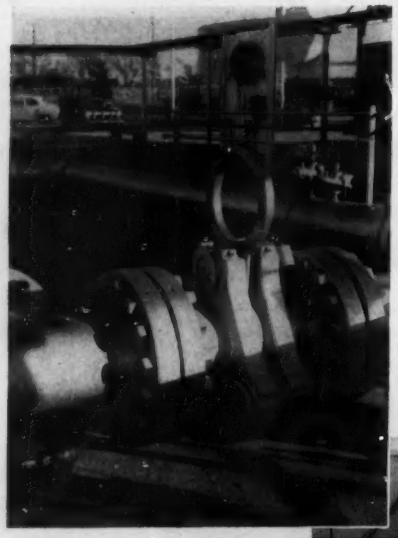

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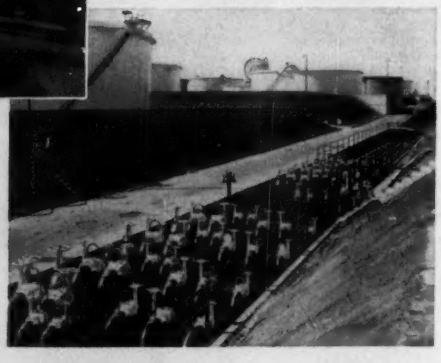

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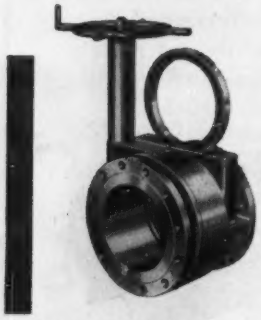

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You will want full performance and dimensional information about these versatile pumps. Call your Weinman pump specialist. He's in the Yellow Pages. Or, write us for Bulletin No. 300.

Two 3G25-2 Weinman Unipumps circulate brine in refrigerating plant for Rockefeller Center Skating Rink, New York City.

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290 SPRUCE STREET · COLUMBUS 15, OHIO
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Chemicals

Acetone.....12-page technical booklet on chemical produced by cumene oxidation process includes data on specifications and typical analysis and partial list of uses.
272A Hercules Powder Co.

Acetonitrile.....Detailed information on acetonitrile as an extractive distillation solvent along with information on azeotropic mixtures of acetonitrile.
107 *Union Carbide Chemicals Co.

Anti-Corrosive Paints.....Technical Bulletin No. 5 describes paint designed for use where decoration is desired along with chemical and heat resistant properties.
272B The Shivell-Hall Co. Inc.

Catalysts.....All types of catalysts as well as catalysts produced exactly to your specifications of raw materials, chemical composition, & physical properties. Booklet.
72 *The Harshaw Chemical Co.

Ceramic Coatings.....Bulletin "Mounting Sensing Elements" describes methods of mounting temperature and strain measuring elements by ceramic spray coatings.
272C Norton Co.

Ceramic Molds.....Bulletin on precision steel castings, produced in ceramic molds, describes relative advantages of process and illustrates examples and applications.
272D Lebanon Steel Foundry

Chemical.....Cyanamer P-250 polyacrylamide imparts high initial tack to adhesive formulations. Has high thickening capacity. Additional information offered.
22-23c *American Cyanamid Co.

Chemicals.....Price list of organic research chemicals and intermediates available in both laboratory and industrial quantities includes 150 different chemicals.
272E Beacon Chemical Industries

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Chemicals.....Tetrapropylene, tripropylene and nonene fulfill the most rigid requirements as basic ingredients for anionic and nonionic detergents. Information available.
306-307 *Enjay Chemical Company

Chemicals.....that help protect against extreme loss by fire or explosion. They include Cellulubes, fire resistant lubricants & hydraulic fluids. Details.
8-9 *Celanese Chemical Co.

Chemicals.....Ninety-four organic and inorganic chemicals are reviewed in 16-page digest. Thumbnail description, physical data, chemical formula and uses are given.
273A Hooker Chemical Corp.

Citric Acid.....is water soluble, easy to handle, and non-toxic. Information about the use of Citric Acid for cleaning stainless steel contained in Bul. 102.
99 *Chas. Pfizer & Co., Inc.

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50 *Hercules Powder Co.

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215 *General Aniline & Film Corp.

Fiberglass Components.....Bulletin describes innate strength, corrosion resistance, and dielectric properties of parts produced through laminating or molding processes.
273B Warminster Fiberglass Co.

Filter Fabrics.....provide maximum resistance to heat. Offer utmost chemical resistance, high abrasion resistance, efficient cake retention-&-discharge properties.
242 *United States Rubber

Filter Media.....not only for filter presses but for other types of filters as well. Also a wide selection of filter paper. Bulletin 141 offered. Send for your copy.
R303 *T. Shriver & Co., Inc.

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Atomics International is seeking qualified engineers and scientists interested in gaining reactor operations and analysis experience in connection with an operating experimental reactor. The following positions are immediately available at the Organic Moderated Reactor Experiment located at the National Reactor Test Site, Arco, Idaho. The OMRE is operated by Atomics International for the Atomic Energy Commission.

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Three to five years experience in chemical industry with emphasis on unit operations. Experience in reactor coolant chemistry desirable but not necessary.

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BS in engineering with knowledge of chemical plant operations. Reactor experience desirable but not necessary. Responsibilities will include direction of reactor operating crews.

Reactor Maintenance

BS in Mechanical Engineering or equivalent. Activities will include directing the maintenance and modification of the existing reactor facility and planning and coordination of future expansion. Knowledge of chemical plant operation and maintenance as well as experience with radiation desirable but not required.

Senior Physicists

MS or PhD with three or more years experience in reactor physics calculations.

Heat Transfer

Engineer with several years experience in heat transfer and mechanical analysis.

Radiochemist

Experience in radiochemistry and use of radiation counting equipment.

Reactor Shift Operators

Three years experience in nuclear reactor operations. Responsibilities will include reactor control together with observation and recording of operating data.

For specific details write: Mr. L. J. Newton, Personnel Office, Atomics International, 8900 DeSoto Avenue, Canoga Park, California.

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A DIVISION OF NORTH AMERICAN AVIATION, INC.

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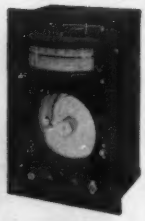
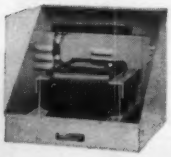
Gardsman by WEST

Model JSBG Stepless Program Controllers



Semi-conductors are grown by a highly integrated process, involving time-temperature control. Only the most precise control delivers the required quality, uniformity, efficiency.

Leading producers of semi-conductors find best results from the market's most compact, integrated Stepless Program Controller: by West. This unit infinitely modulates heater power *and* coordinates time-and-temperature control for even the most unstable systems.



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Glues.....Report describes technical specifications for corrugated container glue-lap production and includes review of synthetic emulsion glues designed for this purpose.
274A The Borden Chemical Co.

Greases, Oils & Lubricants.....There are more than 500 of these specialized greases, oils and lubricants available. Helpful information is offered.
84 *Sinclair Refining Co.

Laminated Plastics.....115-page 1961 edition of Formica Designer's Fact Book contains property and application data, and tolerance and weight specifications.
274B Formica Corp.

Lubricants.....Oil life extended, lubrication costs slashed, maintenance techniques improved, equipment downtime reduced. Additional information available on request.
6-7 *Mobil Oil Company

Masonry Water Repellent.....8-page booklet shows how to achieve masonry protection with silicone resin and discusses common types of damage and their causes.
274C General Electric Co.

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22-23b *American Cyanamid Co.

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260 *Linde Co., Div. of Union Carbide

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228 *C. K. Williams & Co.

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22-23d *American Cyanamid Co.

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274D Witco Chemical Co. Inc.

Polyethylene Resins.....Three new Petrothene polyethylene resins developed. Particularly suited to the blow molding of bottles for drugs, etc. Data sheets.
123-124d *U. S. Industrial Chem. Co.

Polyethylene Resins.....Brochure explains how changes in polyethylene resin properties and extrusion and molding factors affect the properties of blow molded items.
274E U. S. Industrial Chem. Co.

Rubberized Abrasives.....22-page manual lists many uses and applications, and outlines most efficient methods for mounting and dressing. Operating speeds are also listed.
274F Cratex Manufacturing Co. Inc.

*From advertisement, this issue

LITERATURE . . .

Silicone Rubber Insulation.....With charts and graphs, brochure explains manufacturers claim of greater load capacity of wire and cable insulated with Silastic®.
275A Dow Corning Corp.

Single Crystals.....Refractory metals in this new form preserves standard melting points and provides unusual ease of fabrication. Literature includes data and size ranges.
275B Linde Co.

Sodium Process.....A semi-continuous, commercial process for desulfurizing coal tar naphthalene, through treatment with metallic sodium has been developed. Facts.
123-124c *U. S. Industrial Chem. Co.

Trifluoroacetic Acid.....Technical data sheets on Trifluoroacetic Acid plus additional data on the other functional fluoro-organic compounds is offered on request.
89 *Allied Chem., Gen. Chem. Div.

Turbine Oil.....Nonpareil Turbine Oil will not permit formation of harmful acids, has high resistance to foaming, and contains adequate rust inhibitor. Facts.
134 *Standard Oil Co. (Indiana)

Construction Materials

Alloys.....Colmonoy alloys & methods can protect your equipment. The Spraywelder Catalog and the Colmonoy Hard-Surfacing Manual are available.
BL257 *Wall Colmonoy Corp.

Alloys.....Information about the properties and corrosion resistance of Alloy C and other Hastelloy alloys contained in a booklet which is available on request.
219 *Haynes Stellite Company

Chemical Packing.....Style 324 Super-Lon has all the known advantages of Teflon plus 50,000 psi tensile strength contrasted to 2,000 psi limitations in older Teflon Resin.
230 *A. W. Chesterton Co.

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250 *Carboline Co.

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105 *Dow Corning Corp.

Coating.....Kanigen applies a hard, corrosion-resistant nickel alloy coating without the use of electricity. Further information on request.
37 *Gen. American Transp. Corp.

Coating.....“D-A” will withstand temp. up to 600 F. Other Coatings available in a complete range of types for any condition & temp. up to 2200 F. Catalog No. MPC.
FL281 *The Markal Co.

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R305 *National Glaco Chem. Corp.

*From advertisement, this issue

PROTECTOSEAL TSE

fire prevention and vapor control

TANK STORAGE ENGINEERING

In the chemical process industries, particular emphasis must be placed on vapor controls and fire prevention when planning tank storage.

Operating vents installed on flammable liquid storage tanks must incorporate flame arresters. Functionally, the flame arrester protects a tank's contents from fire and explosion by dissipating or reducing the temperature of the exterior flame below the ignition point of vapors on the interior side of the arrester.

Tank operating vents manufactured by The Protectoseal Company are of two basic types: Conservation and Non-Conservation. Conservation Vents (Fig. 1) are designed for installation on tanks where it is desirable

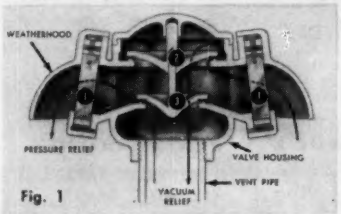

Fig. 1

to reduce evaporation losses. Non-Conservation Vents are often referred to as “free vents” because they are open at all times to permit free flow of air into or out of the tank.

Conservation Vents are equipped with automatically operating vacuum and pressure relief valves which are weighted to relieve at designated settings. The vacuum relief valve (2, Fig. 1) controls the intake of air, and the pressure relief valve (3, Fig. 1) controls the escape of vapors to the atmosphere. Both valves open and close to permit only that intake or outlet relief necessary to keep interior pressures within permissible working limits and avoid damage to the tank.

The flame arresters incorporated in Protectoseal Vents consist of a series of rectangular plates assembled on a single rod to permit rotation of the plates for cleaning. Embossings on the face of each plate provide the correct, uniform air spacing for the flame arresting function.

The flame arrester in Protectoseal Vents is located outside the valve housing to permit easy access for cleaning. Another advantage of placing it outside the housing, in the case of Conservation Vents, is that the arrester protects the valves against atmospheric dirt and weather. In the event of ignition, the vent burns at the arrester, rather than at the valves, thus avoiding warping and distortion of the valve structure.

Emergency Vents For Fire Conditions

In addition to the normal venting capacity provided by the operating vent, every large above-ground flammable liquid storage tank should be provided with some means of relieving excessive internal pressure build-up caused by exposure of the tank to fire. (For tanks of moderate size, the operating vent can be made large enough to serve also as an emergency relief vent). The heat of fire occurring near a flammable liquid storage tank transmitted through the wall of the tank, causes the liquid to vaporize readily. In some petroleum products, this vaporization amounts to roughly 30 or more cubic feet of vapor for every gallon of liquid vaporized. This could generate a relatively high pressure within the confined area of the tank's vapor space. Lacking sufficient emergency relief, an explosion could occur.

Explosions caused by such conditions may be readily avoided by providing adequate emergency vents which permit vapors to escape and burn quietly at the outlets. These emergency vents usually take the form of metal poppet valves (Fig. 2) which are weighted to stay closed under normal pressure conditions and open only when a pre-determined pressure is attained.

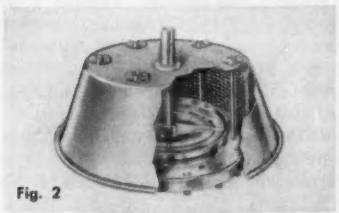
Fig. 2

The Protectoseal Series 7800 Emergency Relief Valve embodies a free-lifting, self-closing valve. A vapor tight metal-to-metal seat is provided by a machined surface on the flanged aluminum base and the underside of the valve. A non-metallic seat can be provided to meet special operating conditions. A weatherhood and a coarse mesh screen covers the entire valve structure.

Technical Assistance Offered

Protectoseal Engineers have long experience in solving corrosion, sublimation, and vapor conservation problems in connection with tank venting equipment. You are invited to submit your problems for analysis and recommendations. TSE—Tank Storage Engineering—is a periodical publication of the Protectoseal Company which provides useful and informative data on the selection, application, and maintenance of storage tank vents, fittings, and related equipment. We will be glad to add your name to the mailing list. There is no obligation. Write:

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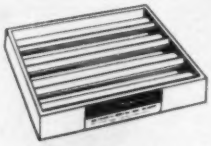
Here are four performance-proved Stearns separators that have introduced a new era of tramp-iron protection for all industry.



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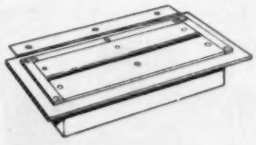

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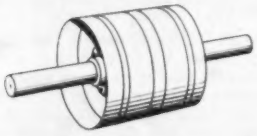
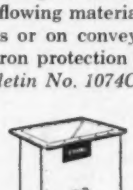


INDOX V MAGNETIC PULLEY

fail-proof protection

Can be installed at head of any belt conveyor system. Outperforms conventional permanent magnet pulleys — equals deep-field power of electromagnetic types. Radial design boosts holding power for maximum separation efficiency. Standard widths and diameters to match your present system. *Ask for Bulletin No. 1022C.*



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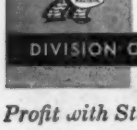

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Compression-Gauge Gaskets.....The gold Flexite Finish for metal gauge rings in these gaskets is new. Highly corrosion resistant. Samples available.
159 *Flexitallic Gasket Co.

Insulation.....Styrofoam insulation prevents condensation . . . helps maintain exact temperatures. Light weight, only 2.4 ounces per board foot. Full information.
227 *The Dow Chemical Co.

Insulation.....A copy of the Insulation Catalog and the Armour Fact Sheet are offered. Data sheets on the complete line of accessory materials for use with Foamglas.
79 *Pittsburgh Corning Corp.

Lead.....is one of the most efficient & economical protection materials against many acids. The Lead Handbook for the chemical process industries is offered. Bul. 162.
138 *American Smelting & Refining Co.

Linings.....Permobond linings can be applied to existing as well as new equipment. Authorized Permobond Service is available. Information on request.
221 *United States Rubber

Packing, Sheet.....Homogeneous Compressed Asbestos Sheet Packing is available in eight different gauges. Gaskets in all sizes & shapes. Bul. CE-90.
304 *Durable Manufacturing Co.

Packings.....“Lattice-Braid” teflon will withstand temperatures ranging from —90 F to +500 F. It is long-lasting & chemically-inert. Information in Catalog AD-131.
48-49a *The Garlock Packing Co.

Packings.....Three kinds of R/M High-Temperature Valve Stem Packings are available. Literature contains more information about these pressure-resistant packings.
262 *Raybestos-Manhattan, Inc.

Packings, Braided.....of new “Teflon” TFE fiber have a distinctive brown color & are available in two basic types. Further information & free sample offered.
33-36 *E. I. du Pont de Nemours & Co.

Platinum Group Metals.....typical uses include linings for vessels, electrical contacts, rupture discs, electrodes, anodes & laboratory ware. Bul. PLA-1.
4 *Texas Instruments Inc.

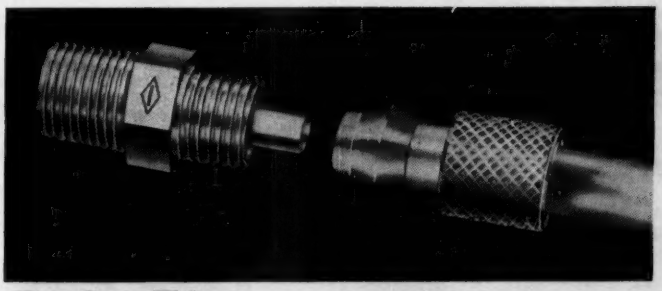
Stainless Steel.....Information on 17-4 PH Stainless Steel. Also folder, “How Armco 17-4 PH Stainless Steel Guards Valve Parts from Corrosion, Erosion, Wear & Galling.
46-47 *Armco Steel

Steel.....With a minimum yield strength of 100,000 psi, plus toughness, weldability, and high resistance, USS “T-1” Steel is ideally suited for industry. Booklet.
16-17 *U. S. Steel Corp.

Electrical & Mechanical

AC-DC Conversion.....Technical data sheet describes, in detail, essential mode of operation and significant waveforms. Functional block diagram is also included.
276A Adage Inc.

*From advertisement, this issue



Poly-Flo tube fittings cut time and labor costs up to 93%

Here's why instrumentation and pneumatic circuit design engineers and many others prefer Imperial Poly-Flo tube fittings and color-coded Polyethylene tubing:

- Time and labor savings up to 93% have been reported with Poly-Flo fittings and polyethylene tubing as compared to metal tubing.
- Polyethylene tubing bends readily by hand.
- Fittings need only be finger-tightened.
- Working pressures to 125 psi (¼" O.D.); 160 psi (5/16" O.D.); 100 psi (⅜" O.D.).
- Temperature range: −90° F. to 175° F.

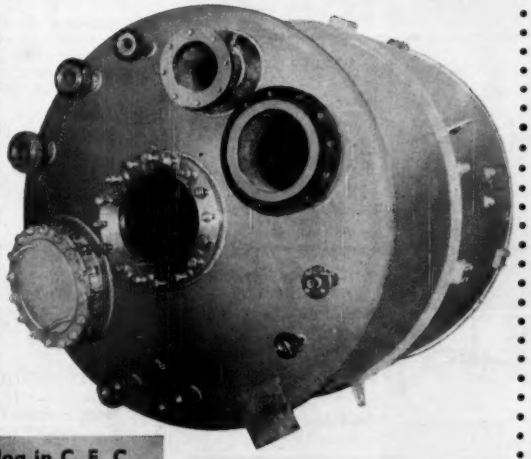
Write for Bulletin No. 3025-C for full facts

IMPERIAL

THE IMPERIAL BRASS MFG. CO.
Dept. CME-90
6300 W. Howard St., Chicago 48, Ill.
In Canada: 18 Hook Ave., Toronto, Ont.

BETHLEHEM *Processing* KETTLES

During the past 50 years, Bethlehem's engineering experience has built unsurpassed know-how and efficiency in building processing kettles. They have been used in the following capacities: Corrosive Service... such as sulphonations, nitrations, reductions. Direct Fired Operations, such as caustic fusions and sodium bi-sulphate manufacture. Heavy Duty Needs, such as processing extremely viscous and pasty materials. Handling Abrasive Solids, especially in the reaction.



See 8-page catalog in C. E. C. for complete facilities of Process Equipment Division of

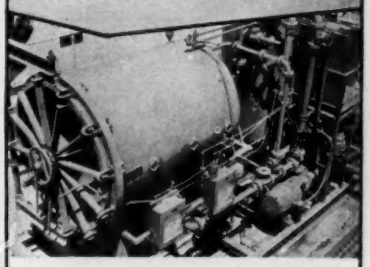
BETHLEHEM FOUNDRY & MACHINE CO.
BETHLEHEM, PENNA.

BETHLEHEM manufactures kettles in cast metals and fabricated steel, stainless steels, alloys, and clad; to ASME Code, other specifications and company standards. X-ray and other test techniques assure sound construction for demanding service.

WRITE FOR BULLETIN 600 to learn more about BETHLEHEM processing kettles for reaction, agitation, heat transfer, distillation, sublimation, crystallization, drying.

Hercules Filters!

FOR HIGH CLARITY AND RAPID CLEANING



"ROTO-JET"
"RAPIDOR"
"D.C.D"
(DRY CAKE DISCHARGE)
"VAC-U-FLO"

All Hercules Filters are characterized by high filtrate-clarity, rapid cleaning, high flow rates, and long filter cycles.

Hercules Filters may be used with any type of filter medium: fibres or diatomaceous or other earths; precoated on metallic or synthetic screens or cloths.

The leaves are cleaned by sluice down, vibration or cake cut off—all within the filter—followed by screw conveyor ejection.

For further details write for illustrated catalog.

HERCULES FILTER CORP.
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HAWTHORNE, NEW JERSEY

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Hawthorne, New Jersey
Please send technical bulletins regarding your filters for:

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COMPANY.....

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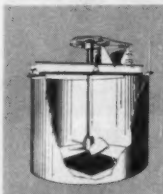
DENVER Equipment

FOR THE CHEMICAL PROCESS INDUSTRY

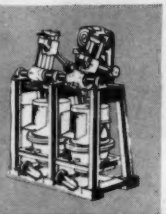


DENVER AGITATORS AND MIXERS

Agitator types available: Turbine-type propeller (to 120" in tanks to 50' dia.), slow speed, high speed, air lift, vertical turbine mixers, mixer-settler units.

Write for Bulletin No. A2-B2

Lab and pilot scale agitators in LG3-B10

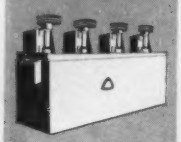


DENVER DIAPHRAGM PUMPS

Stroke can be adjusted while pump is operating. Long wearing nylon-reinforced rubber diaphragm. Sizes 1" to 10" simplex and duplex, capacity to 1000 g.p.m.

Write for Bulletin No. P8-B12

Lab and pilot scale diaphragm pumps in LG3-B10



DENVER ATTRITION SCRUBBERS

High power input to efficiently remove sand coatings, mix dense slurries. Rubber lined or acid-proof tanks. Sizes to 56"x 56"

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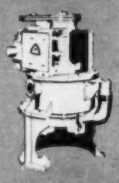
Lab and pilot scale scrubbers in LG3-B10



DENVER VERTICAL CENTRIFUGAL PUMPS

For handling frothy liquids or coarse, sandy slurries, constant or intermittent flow. No packing gland or sealing water. Standard or stainless steel construction. Capacity to 450 g.p.m.

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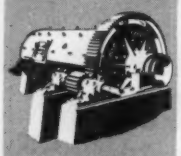
Lab and pilot scale vertical centrifugal pumps in LG3-B10



DENVER BALL AND ROD MILLS

Offer operation and convertibility. Wet or dry grinding systems. All steel construction. Ceramic or rubber linings available. Sizes to 10'x 20'.

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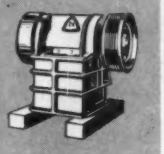
Lab and pilot scale mills in LG3-B10

DENVER SRL (RUBBER LINED) PUMPS

High efficiency, low horsepower. Parts last longer, cost less. Rubber lined. PUMPS AND PARTS IN STOCK. Sizes to 5000 g.p.m. Now available in "TRU-GLANDLESS" construction. No sealing water. No packing glands. No slurry dilution. **Bulletin P9-B28.**

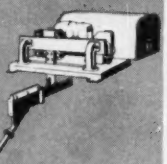


DENVER JAW CRUSHERS

Cast steel frame, anti-friction side bearings and bumper bearings. Manganese steel jaw and cheek plates. Sizes from 2¼"x 3½" to 36"x 48".

Write for Bulletin No. C12-B12

Lab and pilot scale crushers in LG3-B10



DENVER SAMPLERS

Continuous mechanical and automatic types for dry, solution or slurry sampling. Complete sampling plants and sample processing equipment. SAMPLERS IN STOCK.

Write for Bulletin No. S1-B4

Lab and pilot scale samplers in LG3-B10

DENVER REAGENT FEEDERS

Both wet and dry feeders available. Let us know your requirements. Many standard units in stock.

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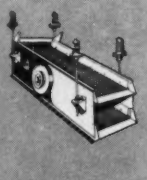
Lab and pilot scale feeders in LG3-B10

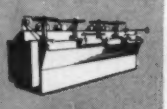


DENVER-DILLON SCREENS

For efficient wet or dry screening. "True-Circle" eccentric action. Sizes to 6'x 14' in stock. Also Trommel Screens in sizes from 30"x 60"x 120".

Write for Bulletin No. S3-B15

Lab and pilot scale screens in LG3-B10

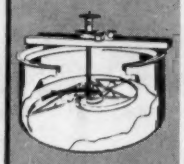


DENVER "SUB-A" FLOTATION

Universal tank with three types of mechanisms: (a) "Cell-to-Cell"; (b) "Free-Flow"; (c) Type "M". Sizes from 16"x 16" to 72"x 72".

Write for Bulletin No. F10-B86

Lab and pilot scale flotation in LG3-B10



DENVER SPIRAL RAKE THICKENERS

Move settled materials to center in one revolution. Simple, efficient, heavy-duty gear mechanism for thickeners to 150' dia. Acid proof construction available.

Write for Bulletin No. T5-B6

Lab & pilot scale thickeners in LG3-B10

DENVER EQUIPMENT COMPANY

Box 5268, Denver 17, Colorado
Phone CHerry 4-4466

SEE OUR CATALOG ON PAGES 949-956 IN C.E.C.

DENVER TESTING FACILITIES

You will have problems in crushing, grinding, settling and possibly concentration and filtering. These are our specialties so please let us help you in our Test Department. Deco flowsheets are reliable and proven.

LITERATURE . . .

Expansion Joints.....Catalog AD-137 contains complete information on solid teflon and teflon-lined expansion joints for the chemical processing applications.
48-49d *The Garlock Packing Co.

Gaskets, Teflon-jacketed.....in 4 basic designs; slit envelope, milled envelope, formed shield, double jacket & a wide selection of filler materials & thicknesses. Cat. AD-154.
48-49c *The Garlock Packing Co.

Gear-Driven Swivel Joints.....are available in 2, 2½, 3 and 4 inch sizes. Size & type to meet every requirement. Full catalog and price information.
115 *Continental-Emsco Co.

Mechanical Seals.....Chemiseal mechanical seals are available in standard sizes to fit all pump shafts ⅞" to 2⅛" shaft. Details in Catalog AD-164.
48-49b *The Garlock Packing Co.

Motors.....Types RP, YP, & ZP motors are described in Bulletins MU-239 and MU-232. Perfect drives for big pumps, fans, blowers, compressors; any heavy duty application.
81-82a *Wagner Electric Corp.

Motors.....Type EP and Type JP totally-enclosed fan-cooled motors are built in ratings through 100 hp in NEMA frame sizes 182-445U. Bulletin MU-2241 & MU-224.
81-82b *Wagner Electric Corp.

Seal.....is available in two-bolt clamp-type or conventional flange connections. Stock connections available from ½" to 30" & on special order. Grayloc Catalog.
236 *Gray Tool Co.

Speed Reducers.....Brochure contains technical data on shaft-mounted geared speed reducers plus illustrations, descriptions and selection and ordering instructions.
278A U. S. Electrical Motors Inc.

Starters.....Available in ratings up to 900 hp, size 6, 7 and 8 starters can be ordered as open devices, or in general purpose, dust-tight and water-tight enclosures. Bul. 8536.
65 *Square D Company

Thermocouples.....Megopak small-diameter assemblies come complete with terminations and mounting attachments. Complete details in Catalog G100-4.
109 *Minneapolis-Honeywell

Welded Impeller.....Information on the new welded impeller that permits higher horsepower, higher tip speeds, & greater design flexibility available on request.
245 *DeLaval Steam Turbine Co.

Handling & Packaging

Bag, Sterile Polyethylene.....with no-leak closure shows promise as sterile pack. Containers are made of clear heavy polyethylene tubing, sealed both top & bottom.
123-124b *U. S. Industrial Chem. Co.

Conveyor Idlers.....8-page booklet contains selection data on 60 new 35° deep trough idlers and 24 new 45° idlers that carry such heavy materials as crushed stone and ore.
278B Link-Belt Co.

*From advertisement, this issue

LITERATURE . . .

Conveyors.....Revised general catalog covers new products and techniques and includes section on the principles of a co-ordinated materials handling system.
279A The Rapids-Standard Co.

Conveyors, Oscillating.....Flexmount for light-duty, Coilmount for medium-duty, and Torqmount for heavy-duty service. New Book 2744 contains complete data.
67 *Link-Belt Co.

Dumpmaster Hauler.....Brochure describes the service of the Dempster-Dumpmaster equipped hauler in detail. Provides containers & service for small fee.
68 *Dempster Brothers

Idler.....New 44-page Idler bulletin describes the more than 800 units available in the complete line. Covers all features. Copy will be sent on request.
20-21 *Barber-Greene

Material Handling.....The Hoistractor is an air-powered hoist trolley connected to the hoist by a draw-bar. Both units ride the same beam. Bulletins.
255 *Gardner Denver

Materials Handling....."Payloader units are available up to 12,000 operating capacity. Literature entitled, "Industrial Materials Handling the Payloader Way" available.
125 *The Frank G. Hough Company

Metal-Mesh Belts.....combine movement with processing to give you greater production & consistently high quality without costly manual handling. 130-Pg. Manual.
76 *The Cambridge Wire Cloth Co.

Vibratory Feeders.....are completely automatic, extremely accurate. Fully enclosed drive element makes units dust & moisture resistant. Comprehensive literature.
279B Eriez Mfg. Co.

Weight-Control.....The new Condensed Catalog 2001 tells how modern Toledos will fit your needs . . . whatever your weighing problems. Available now on request.
258 *Toledo Scale Corp.

Heating & Cooling

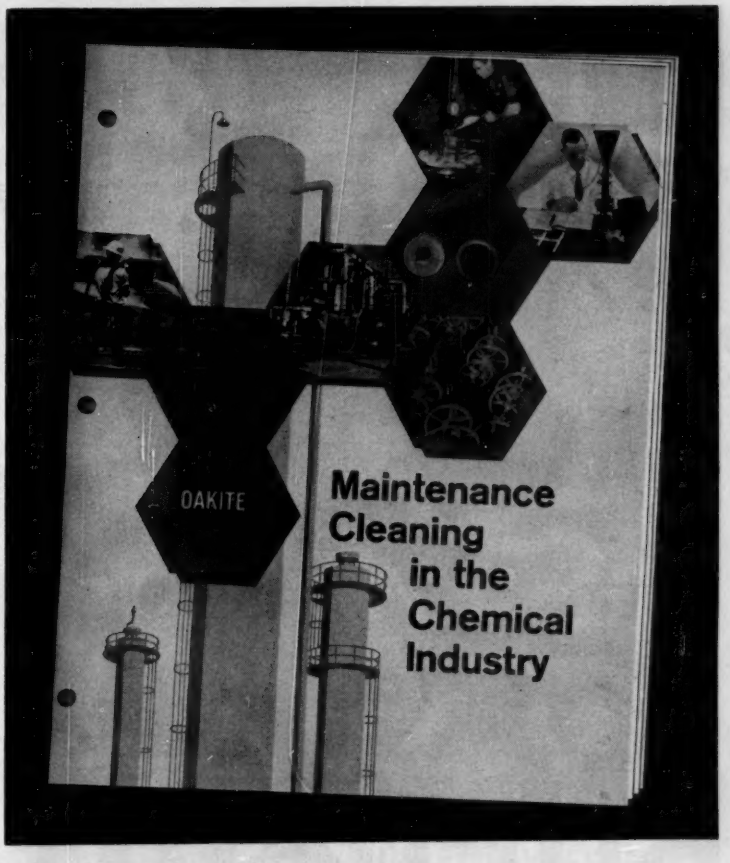
Air Preheater . . . Information on the Ljungstrom continuous regenerative principle, or on the Air Preheater that meets your requirements is available.
247 *The Air Preheater Corp.

Boilers.....Bulletins describe the Modulatic Water Tube Boilers. Furnish high or low-pressure steam (at design pressures up to 1000 psi, or even higher).
263 *Vapor Heating Corp.

Compressor.....The ADL-two-stage, air cooled, 20 hp, two-cylinder unit offers discharge pressure up to 125 psi, or as high as 250 psi on intermittent service.
254 *Gardner-Denver Co.

Generator, Inert Gas.....Units are supplied as complete packages & include all control & safety equip. Detailed information is contained in Bulletin #114B.
253 *Thermal Research & Engineering

*From advertisement, this issue



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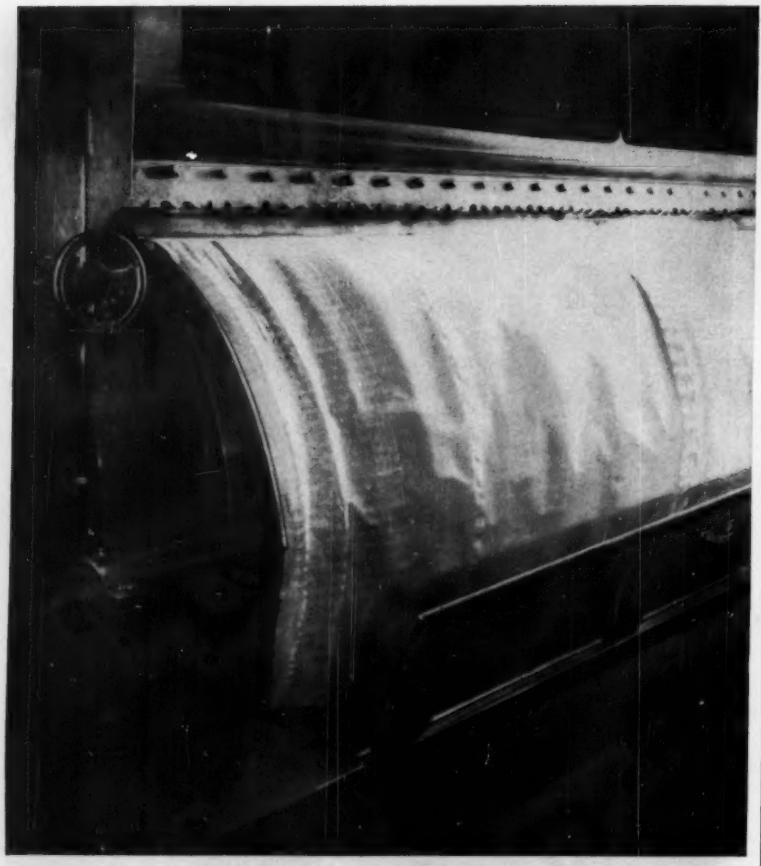

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Drum Dryers

for chemicals; detergents, pharmaceuticals, waste pigments, insecticides, resin, clay, rubber sludge and solvent recovery

Whatever your material in process may be, Buflovak Equipment will provide the way to the most profitable operation. Vacuum or atmospheric, single or double drum, Buflovak can job-tailor the dryer for your product. For details, write for Catalog 384, Buflovak Equipment Division, 1551 Fillmore Avenue, Buffalo 11, New York.

Buflovak Equipment Division

BLAW-KNOX

LITERATURE . . .

Cryogenerators.....Facilities for research, design & fabrication are available for any industrial problem involving low temperature application. Information.
10-11 *Norelco Cryogenerators, Inc.

Generators.....Blanketing operation are No. 1 prospects for the Nitro-Gen . . . in food, paint, petroleum, chemical, and petrochemical industries. Bul. 5901-NI.
261 *C. I. Hayes, Inc.

Heating.....Cal-Cord is a new, flexible cord developed especially for high temperature laboratory heating applications. Two sizes, 400 C & 600 C. Information.
248 *Glas-Col

Heating Equipment.....The complete story on Grid unit heaters, blast heats, & Grid radiation for chemical use are contained in catalog No. 956.
147 *D. J. Murray Mfg. Co.

Heat Exchangers.....New 4-color Bul. 820 describes & illustrates the complete line including Standardized Heat Exchangers that fulfill nearly all normal requirements.
R257 *Manning & Lewis Engr. Co.

Heat Exchangers.....A unique feature of these exchangers is that the tube side can be cleaned while in operation. Bulletin HE-8 describes this unusual and standard equipment.
201 *Henry Vogt Machine Co.

Heat Exchanger, Zirconium.....The first heat exchanger has successfully been fabricated from zirconium & is part of unit to concentrate H_2O_2 solutions.
123-124e *U. S. Industrial Chem. Co.

Heater.....Hi-Turbiant offers two broad fields of application; heating transfer fluids and direct firing. Illustrated bulletin HT-100 gives detailed data.
136 *Western Precipitation

Heat Transfer.....New Multi-Zone Platecoil offers operating pressures up to 250 psi in all kinds of tank and process heating. Bulletin P 61 for more data.
141 *Tranter Mfg., Inc.

Ovens.....Information on truck ovens and Electric, tray-loading cabinet ovens is contained in Bulletin 127. Feature fast-uniform drying, baking, and curing.
TL303 *W. S. Rockwell Co.

Steam Traps.....A 48-pg. book tells how to correctly size, install & maintain steam traps for any pressure, temperature or any load. Also Catalog K for data.
162 *Armstrong Machine Works

Steam Traps.....Thermostatic steam traps are covered in Catalog #400. Practically no moving parts, no links, no pins. No adjustable orifices to stick or clog.
302 *W. H. Nicholson & Co.

Steam Traps.....Five types available; Thermo-Dynamic, Thermostatic, Float-Thermostatic, Liquid Expansion, and Bucket. Literature to help you with trapping problems.
12-13 *Sarco Company, Inc.

Thermo-Panels.....for the utmost in drum warming or cooling modern chemicals. Complete data & costs on thermo-panel drum warmer or cooler in Form DW-6-1.
C231 *Dean Products Inc.

* From advertisement, this issue

Protects Metals Against Hot Acids, Acid and Sulfurous Fumes, Salt Spray, Steam, Mild Alkalies, Up to 600° F.

Markal "D-A" Coatings will protect metal against any corrosive action. It is an ideal product for ore sintering plants, plating plants, food plants, lumber kilns, foundries, chemical plants, sewage disposal plants, laundries, heat exchangers . . . many others.

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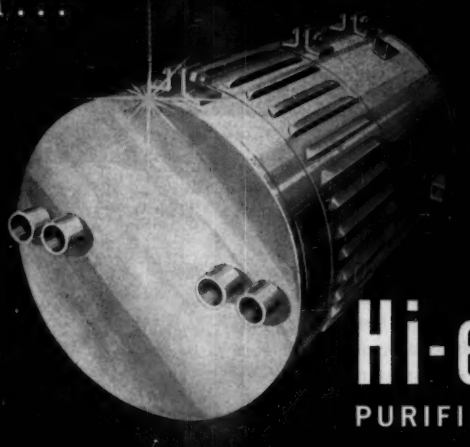
Other Markal Coatings are available in a complete range of types for any condition and temperatures up to 2200°F. Send for catalog No. MPC.

The Markal Company, 3106 West Carroll Avenue, Chicago 12, Ill.
Telephone SAcramento 2-6085

steam process headaches are quickly relieved with . . .



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Remove damaging particles, line scale, condensate, oil from steam processes. Prevent slugs and riser discharge in evaporator and boiler service. Hi-eF separation guaranteed better than 99% efficient. No moving parts, filters or screens result in low-cost, maintenance-free performance. SPECIFICATION MANUAL 803 contains data on 13 types of purifiers, separators, mist extractors, scrubbers. Write.

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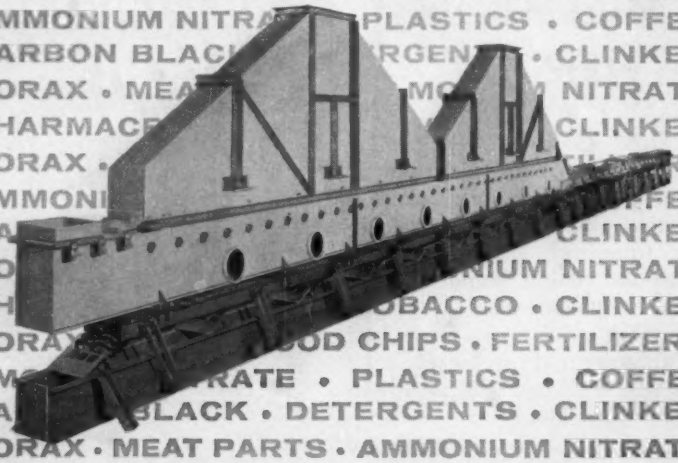

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cooling-drying ON THE RUN!

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The conveyor shown above dries, screens and conveys carbonaceous particles at the rate of over 2 t.p.h. Moisture is reduced from 14% to ½% using 350° F. air in just the first 30 feet. Material is conveyed a total of 80 feet.

HERE'S WHAT CARRIER "CUSTOM ENGINEERED" CONVEYORS CAN DO FOR YOU

SAVE SPACE...require less headroom ...can elevate material as well as straight-line convey. Simple accessories make possible additional operations such as screening...lump breaking...sampling.

REDUCE COSTS...double-duty Carrier Conveyors eliminate need for multiple units. Operating and maintenance costs are far lower than for other types of process equipment.

INCREASE CAPACITY...size for size... job for job. Carrier Conveyors assure maximum capacity and greater return on your investment.

PROTECT PRODUCTS...gentle Natural Frequency conveying action protects fragile crystals or pellets. There is no product breakdown...no segregation. Simple, easy-to-clean troughs keep food and pharmaceuticals contamination-free.

Carrier laboratories will provide test data on your materials. Write Carrier Conveyor Division, CHAIN Belt Company, 214 North Jackson Street, Louisville 2, Kentucky.

CARRIER CONVEYOR
-NATURAL-FREQUENCY-
VIBRATING EQUIPMENT
CHAIN BELT COMPANY

CONVEY • FEED
DEWATER • SCREEN
COOL • DRY
SCALP • COAT
DISTRIBUTE • ELEVATE

LITERATURE . . .

Instruments & Controls

Analyzer-Recorder.....Measures & records excess air & the mixing efficiency of your fuel-burning equipment. Details in Product Specifications E65-1 & E12-5.
52 *Bailey Meter Co.

Comparators.....Handbook, "Modern pH and Chlorine Control" contains 101 pages of tech. data & useful information. Gives theory & application of pH control.
L231 *W. A. Taylor & Co.

Computer System.....The Libratrol 1000 offers many features. Sequencing is changeable by program. New Libratrol brochure contains specifications & operation.
165 *General Precision, Inc.

Control Panels.....automatic, remote, one-man control of multiple operations. Also manufacturers of pneumatic conveying equipment. Bulletin G-9.
69 *Fuller Co.

Controllers.....The Model JSBG infinitely modulates heater power and coordinates time-and-temperature control for even the most unstable systems. Bulletins.
274 *West Instrument Corp.

Control Station.....New Electrik Tel-O-Set assures easier bumpless transder than ever before because there's no need to "line-up" or "match" pointers. Complete details.
42-43 *Minneapolis-Honeywell

Control Systems.....Provide maximum automation for data acquisition, transmission, recording and control of process variables. Technical Bulletin 10 available on request.
61 *Robertshaw-Fulton Controls Co.

Gauges.....Complete information about the Maxitest or the complete line of Ashcroft test gauges and gauge testers is contained in Catalog 300 B.
55 *Manning, Maxwell & Moore, Inc.

Gauges.....The new "Master Test" series in sizes 4½", 6", 8". All standard pressure ranges 0-15 psi to 0-30,000 psi, vacuum & compound. New 20-page bulletin.
TL305 *Marsh Instrument Co.

Heat Transfer.....Multi-Zone plate-coil offers effective heat transfer & more heat transfer per square foot of area. Complete data in Bulletin P61.
141 *Tranter Mfg. Inc.

Pneumatic Instruments.....The new Null-Balance-Vector line of pneumatic instruments includes: temperature transmitters, pressure transmitters, relays, etc. Facts.
60 *Republic Flow Meters Co.

Pressure Controller A completely descriptive and illustrated bulletin on the Wizard II is available as well as a bulletin on Wizard I. Bul. D-4150B & Bul. D4100.
78 *Fisher Governor Co.

Recorders.....The tremendous power of the 90J (pneumatic) and the 700J (electronic) recorders gives you greater accuracy than ever before. Bulletins 98286 and 98335 offered.
18-19 *Taylor Instrument Companies

*From advertisement, this issue

Temperature Control.....Available in Pneumatic, Electric or Self-Contained Gas types, in recording, indicating or non-indicating models. Full details.
75 *The Partlow Corp.

Thermometers.....American Bi-Metal thermometers feature the two-level "Maxivision" dial which eliminates parallax effects. Made of weatherproof stainless steel. Cat. 100A.
128 *Manning, Maxwell & Moore, Inc.

Ultrasonic Test Unit.....The fully transistorized Sonizon SO-300 may be used on practically any solid from .025 to 2.50" thick. Further information or demonstration.
TL257 *Magnaflux Corp.

Pipe, Fittings, Valves

Fittings & Flanges.....Welding fittings & flanges are available in carbon steel & the B&W Croloys in a complete range of types & sizes. Bulletin FB502 offered.
170 *The Babcock & Wilcox Co.

Pipe.....Data on Fluoroflex-lined steel pipe is offered. Features no corrosion, no leakage. Comes in sizes & lengths specified in your piping plan.
223 *Resistoflex Corp.

Pipe.....Koroseal PVC pipe is unaffected by most alkalies, acids, salt, alcohol and oil. It does not react chemically, will not contaminate liquids. Booklet offered.
1 *B. F. Goodrich Ind. Products Co.

Pipe, Plastic.....Catalog sheet describes unique advantages of plastic pipe for industrial piping jobs and lists some common uses. Included are illustrations of installations.
283A Republic Steel Corp.

Tube.....Detailed data on Cupralum as well as data on the full line of Anaconda copper & copper-alloy tubes is available. Technical assistance in meeting problems.
103 *The American Brass Co.

Tube & Pipe.....The 3 major systems of joining all pipe are used with equal success on Fibercast pipe. A free sample of Fibercast and further information on request.
233 *Fibercast Co.

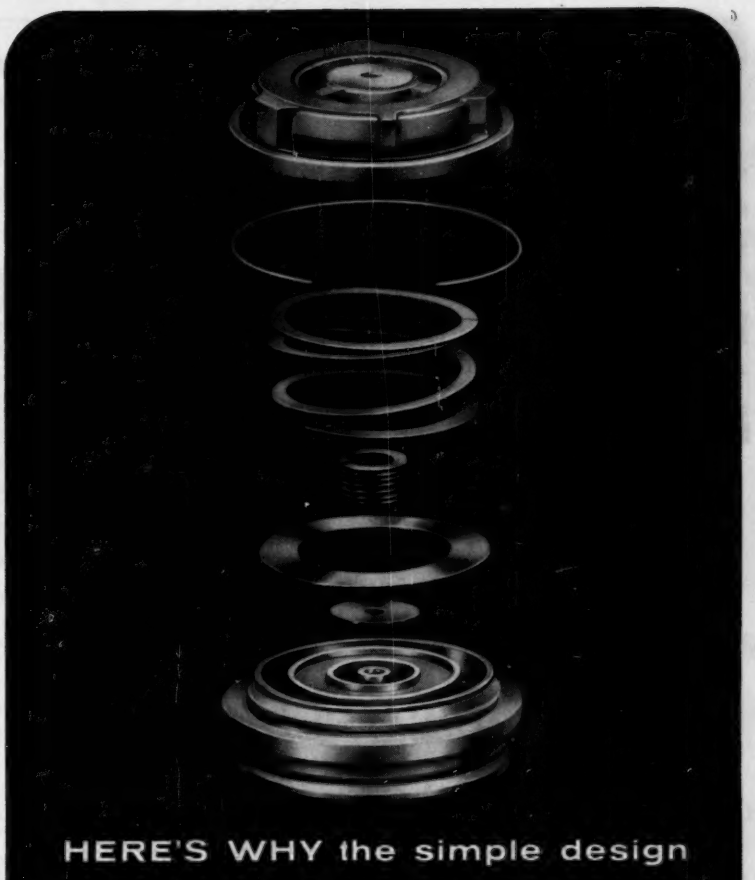
Tube Fittings.....Poly-Flo tube fittings offer working pressures to 125 psi (¼" O.D.); 160 psi (⅛" O.D.); 100 psi (⅜" O.D.). Bulletin No. 3025 C for facts.
TL277 *Imperial Brass Mfg. Co.

Tubing, Stainless Steel.....Lengths up to 60 feet. ⅛" to 6⅝" O. D. Wall thickness from .008" to .154" depending upon O. D. and application. New folder offered.
54 *The Wallingford Steel Co.

Valve.....for blending, milling, conveying applications . . . wherever powders or granulations require flow control. Product Data Sheet 18V is offered.
BL285 *Patterson-Kelley

Valve, Ball.....The Econ-O-Miser Ball Valve is available from ¼" through 6" size range. Suited to difficult media because of its smooth round flow & quarter-turn operation.
73 *Worcester Valve Co., Inc.

*From advertisement, this issue

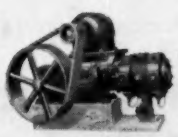


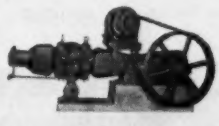
makes PENNSYLVANIA COMPRESSORS run efficiently...silently...with minimum maintenance.

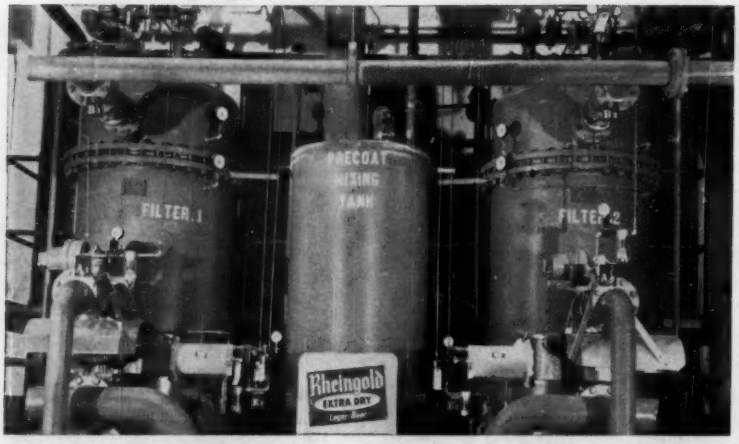
Stainless steel valve discs lift against a cushion of air in the simple, efficient design of the Air Cushion Valve that makes PENNSYLVANIA Compressors run so silently, so dependably, and with such low maintenance requirements. Air Cushion Valves have no nuts, bolts, or screws to break or burn fast. You get longer valve life . . . eliminate wear . . . eliminate noise caused by metal striking metal. Flat valve discs have no flexing or bending action to weaken or distort them. And the valve springs are highest grade stainless steel, rolled on edge, insuring maximum strength and durability. There is just one spring for each disc, and it bears evenly on the entire surface.

But this is only part of the PENNSYLVANIA story. Learn all the facts in "Compressors for Industry". It describes PENNSYLVANIA Compressors from 10 to 350 hp, horizontal, angle, and OILFRE models. Write to Dept. B-8 for your copy today.

PENNSYLVANIA
PUMP AND COMPRESSOR COMPANY
Easton, Pa. • Earning Customer Confidence Since 1920







OPERATES ITSELF... PAYS FOR ITSELF!

ADAMS AUTOMATED FILTRATION

Crystal-clear filtrate, without manual attention, is the money-saving advantage enjoyed by plants using Adams automated IWF Filter plants!

A good example is the Liebmann Breweries, Inc. plant shown above. All operations are automatically sequenced by timers. Valves are pneumatically actuated to backwash, precoat and put each unit on stream in sequence. Labor savings are expected to amortize the plant in a year. It is highly possible that you can do just as well while enjoying the exclusive benefits of Adams filtration — its high-polish filtrate — its rapid, thorough "Pressure Dome" backwashing requiring a minimum of wash liquid — its continuous filter-aid feed that prolongs filter cycles — its compact size and simplicity of piping that means major installation savings.

Why not investigate these benefits plus the following additional advantages of Adams Automated Filtration:

- Remote location of plants now highly practical because of minimum attention.
- Adaptability to a wide choice of systems — every IWF Adams Filter can be automated.
- Automated Filter plants need less valuable plant space — multiple installations require smaller individual units.
- Backwashing downtime is greatly reduced. Automatic operation yields more uniform operation — human error virtually eliminated.

Write today for complete details and Automatic Filtration Report 147.

R. P. ADAMS COMPANY, INC.

207 East Park Drive • Buffalo 17, New York

LITERATURE . . .

Valves.....Weld-End butterfly valves offer inlet pressure up to 6000 psi and pressure drops to 550 psi. Sizes range from 1" to 4". Details in Bulletin No. 77.
TL265 *Fisher Governor Co.

Valves.....All kinds are available, gate, glove, angle, check, "Y", relief, flush bottom tank valves, etc. Illustrated literature on all types available on request.
217 *The Wm. Powell Co.

Valves, Ball.....Plastic ball valves feature quick ¼ turn shut-off, adjustable seats, full flow characteristics, no sticking or scaling, etc. Catalog.
244 *Chemtrol

Valves, Ball.....Fullport Compression-Mounted in stainless steel in sizes ½" through 6". They test to 1000 psi cold non shick service & 300 psi at 400 F. Catalog #BVFA.
241 *Cooper Alloy Corp.

Valves, Ball.....Seven data sheets giving various information about a complete line of "Double-Seal" Ball Valves and accessories are now available on request.
145 *Jamesbury Corp.

Valves, Ball.....available in piping sizes ⅜" through 16" in screwed ends 150 lb. & 300 lb. flanges. All sizes available with 2 retainer springs & 2 Teflon seats. Folder.
235 *Rockwood Sprinkler Co.

Valves, Control.....A copy of an informal booklet called "25 Ways To Be Right" . . . in selecting control valve is now available on request.
14-15 *Minneapolis Honeywell

Valves, Packless.....feature bellows of brass, phosphor bronze, monel, or stainless steel . . . depending on various conditions of temp. pressure or atmosphere. Cat. SC-F.
252 *Robertshaw-Fulton Controls Co.

Valve, Safety-Relief.....is ideally suited for both pressure & vacuum relief. Seals against liquids & gases. Pyrex & Teflon construction. Bulletin RV-1.
R287 *Chem Flow Corp.

Valves & Fittings, PVC.....Are designed to regulate the flow of alkalies, acids, & similar corrosive fluids. They are nontoxic, non-aging and cannot corrode. Literature.
56 *Walworth

Process Equipment

Agitators & Mixers.....Turbine-type propeller (to 120" in tanks to 50" dia.) slow speed, high speed, air lift, vertical turbine mixers, mixer-settler units. Bul. A2-B2.
278a *Denver Equip. Co.

Attrition Scrubbers.....High power input to efficiently remove sand coating, mix dense slurries. Rubber lined or acid-proof tanks. Sizes to 56" 56". Bul. A-8505.
278b *Denver Equipment Co.

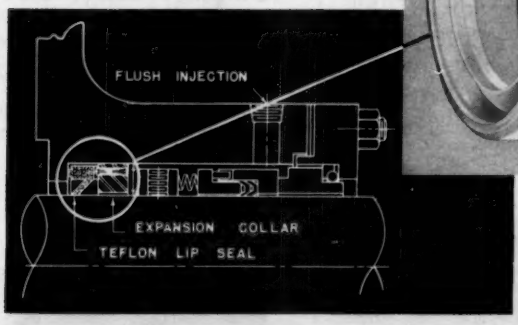
Mills, Ball & Rod.....offer operation & convertibility. Wet or dry grinding systems. Sizes to 10' x 20'. All steel construction. Bulletin B2-B20 is now available.
278c *Denver Equip. Co.

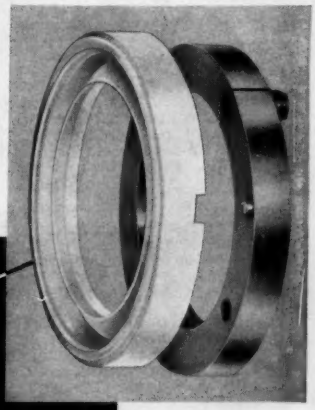
*From advertisement, this issue

DURA LIP SEAL

For use with Dura Seal to control liquid injection in stuffing boxes

FOR HANDLING ABRASIVE FLUIDS AND SLURRIES





DURA LIP SEAL

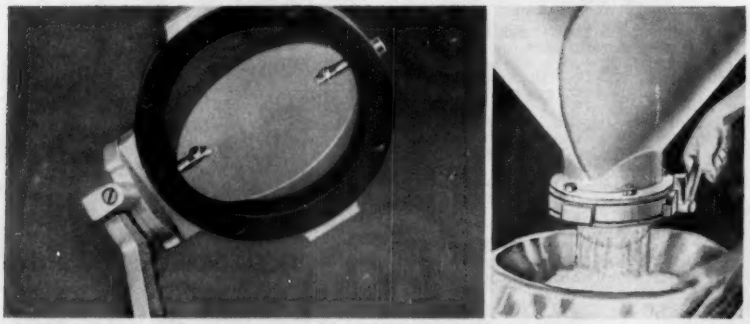
Composed of two parts: Left, Teflon lip sealing ring; Right, split expansion Collar for retaining lip sealing ring in operating position.

DURA LIP SEAL provides a flow control for liquid injection in stuffing boxes. Its purpose is to prevent abrasives in the process fluid from interfering with the function of the Dura Seal. A split Collar is expanded firmly against the stuffing box bore retaining a Teflon lip sealing ring that regulates the amount of dilution. FOR MORE INFORMATION, WRITE FOR BULLETIN NO. 491 CE

The PERFECT SEAL

DURAMETALLIC CORPORATION
KALAMAZOO, MICHIGAN

ALL-NEOPRENE-STAINLESS P-K SOLIDS FLOW VALVE



AS LOW AS $96.00

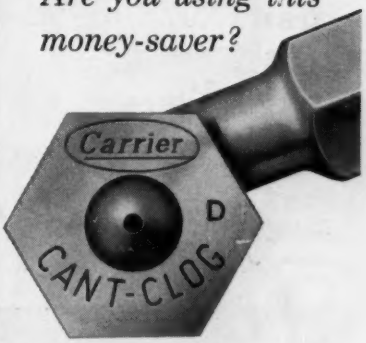
Install this compact P-K valve for blending, milling, conveying applications – wherever powders or granulations require flow control. All parts, including neoprene liner, are interchangeable and easily replaceable in field. Precision machined.

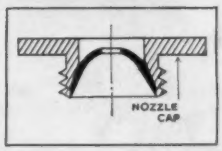
Among accessories – air actuator, 90° rotation; adapter to fit P-K valve to existing equipment; plastic bag adapter; positive pressure of vacuum tight cover. Sizes 6", 8", 10", 12".

Send for Product Data Sheet 18V – today.

Patterson Kelley
Chemical and Process Equipment Div., East Stroudsburg, Penna.

Are you using this money-saver?





UNIQUE Carrier "CANT-CLOG" SPRAY NOZZLE

for air washers, cooling towers and spray equipment

- **Self-cleaning—cuts maintenance costs**
- **No down time due to clogged sprays**
- **Maintains high equipment performance**
- **Installed in seconds**

Many years of use in scores of applications testify to the efficiency of this revolutionary centrifugal-type spray nozzle. It is available as a replacement on all makes of spray and air washer equipment—as caps only or complete nozzles.

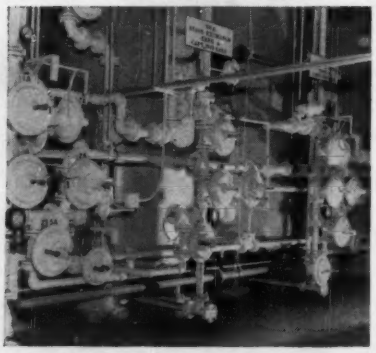
Besides the advantages listed above, it is low in cost. And since the orifice is formed in a flexible Buna-N rubber dome, erosion normally caused by water-borne particles is eliminated. You get longer nozzle life, less down time and better equipment performance.

Interested in ratings and complete information on this money-saver? Write Carrier Air Conditioning Company, Syracuse, N. Y.

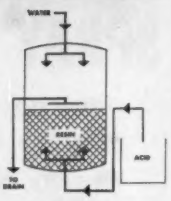
Carrier

HIRAM WALKER uses...

ILLCO-WAY ionXchange



Right, a diagram of the IWT Counterflow* system of regeneration, whereby a downward flow produces a "barrier" to keep the bed from being expanded by the upward flow of regenerant.



DISSOLVED SOLIDS IN RAW WATER REDUCED FROM 570 TO 3 PPM USING "COUNTERFLOW"

At the Hiram Walker distillery in Peoria, Illinois, the IWT equipment shown above is used to provide purified water for adjusting proof of various alcoholic beverages. It consists of *automatic* Counterflow* cation exchangers, automatic weakly-basic anion exchangers, and a vacuum degasifier. The de-ionized water is suitable for beverage use *without any need for activated carbon filtration*, because the resins used do not add any taste, color, or odor to the water. The equipment, after 2½ years, is still giving rated capacity of 140,000 gallons in each 24 hours. Quality, proposed at 5 ppm, actually runs mostly at 1 ppm with a maximum of 3 ppm. Counterflow* regeneration provides lowest operating cost through reduced regenerant dosages.

* U.S. Pat. 2,891,007

IWT LEADS THE WAY

The experience which enabled IWT to produce this excellent performance at Hiram Walker has been gained through intensive pioneering in the important phases of the ion-exchange process ever since its introduction in 1937.

ILLINOIS WATER TREATMENT CO.
840 CEDAR ST., ROCKFORD, ILLINOIS
NEW YORK OFFICE: 141 E. 44th St., New York 17, N.Y.
CANADIAN DIST.: Pumps & Softeners, Ltd., London, Ont.

LITERATURE . . .

Centrifuge.....The P-600 Super-D-Canter continuously handles a wide range of particle sizes in slurries with solids concentration from ½ to 50%. Bul. 1287.
135a *The Sharples Corp.

Crushers.....Bulletin "How To Select a Crusher" describes the various kinds of mechanical reduction & the types of Pennsylvania crushers that supply each one.
55 *Bath Iron Works, Penn. Crusher

Crushing & Grinding.....Bulletin No. 067 gives description of all laboratory machines including Crushing Rolls, Jaw Crushers, Swing-Sledge Mill, & Sample Grinder.
R286 *Sturtevant Mill Co.

Drum Dryers.....for chemicals; detergents, pharmaceuticals, waste pigments, insecticides, resin, clay, rubber sludge, & solvent recovery. Details in Cat. 384.
280 *Blaw-Knox

Dryer.....The all-new SCL dryer offers neat lower housing, complete accessibility of all internal parts & many other features. Copy of Bulletin No. 462 available.
57 *Proctor & Schwartz, Inc.

Dryer.....The Rotary Steam Tube Dryer in size 8'-0" x 45'-0" is described in Catalog "A". Covers your Pressing and Drying problems.
BL265 *Davenport Mach. & Foundry Co.

Dryer, Vacuum Chamber.....Phenolic resin-lined double door chamber dryer designed to process heat-sensitive chemicals. Cat. 201 describes all Drying Equipment.
301 *J. P. Devine Mfg. Co.

Dryers.....A complete range of capacities in heat-reactivated type dryers. Complete dryer & accessory technical manuals are available on request.
249 *Trinity Equipment Corp.

Dust Filters.....The new "Roll-Clean" Dynaclone gives: continuous cleaning, constant suction & complete accessibility in the least possible space. Catalog 104.
291 *The W. W. Sly Mfg. Co.

Evaporator Stripper.....is particularly useful for recovering chlorinated hydrocarbons from relatively non-volatile contaminants with a high rate of solvent recovery.
238 *Artisan Metal Products, Inc.

Filtration.....Automated Filter plants need less valuable plant space, multiple installations require smaller individual units. Automatic Filtration Report 147.
284 *R. P. Adams Co., Inc.

Filtration.....A complete line including filter presses, closing devices, and filter media. Information on complete technical service & filtration service in catalog.
63 *D. R. Sperry & Co.

Filtration.....Complete information about filter fabrics is now available. Distributors' names and a handy information booklet on request. Inquire now.
161 *Wellington Sears Co.

Filter.....Freedom from blinding is one of the several ways the new EimcoBelt filter is greatly extending the usefulness of vacuum filters. Bul. F-2053.
Cover *The Eimco Corp.

*From advertisement, this issue

Take Guesswork Out of Lab Crushing & Grinding

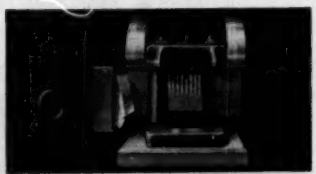
Sturtevant Design Provides Easy Access for Cleanouts — Returns Complete Sample

In seconds, because of "Open-Door" accessibility, all Sturtevant crushing or grinding parts are exposed for thorough cleanouts. 100% sample return is easy to secure.

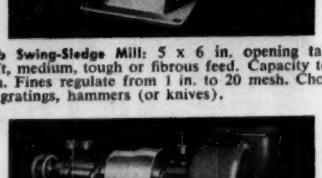
Sturtevant laboratory machines are ruggedly constructed — design, based on production models, gives top lab or pilot performance.

Send for Bulletin No.067, which gives full description of all Sturtevant laboratory machines.

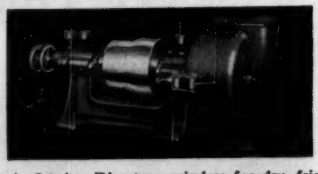
Lab Crushing Rolls: Special lab design. Two models: 8 x 5 in. and 12 x 12 in. rolls. Capacities to 10 tph. Both models adjust down to 20 mesh. Tires of high carbon forgings. Automatic feeder, adjustable controls.



Lab Jaw Crusher: Crushes hardest rocks at ½ to ⅛ in. settings. Roll jaw action — no clogging. Feed opening 2 x 6 in. Capacity to 1900 lbs. per hr. at ½ in. setting. Instant adjustment. Manganese jaws, reversible shield.



Lab Swing-Sledge Mill: 5 x 6 in. opening takes soft, medium, tough or fibrous feed. Capacity to 1 tph. Fines regulate from 1 in. to 20 mesh. Choice of gratings, hammers (or knives).



Sample Grinder: Disc type grinders for dry, friable soft or medium materials. Three sizes — 6 in., 10 in., and 14 in. take feed as coarse as ¼ in. Produces 100 mesh fines at capacities to 200 lbs. per hr. on largest model. Regulate 10 to 100 mesh. In-operation adjustment.

STURTEVANT MILL COMPANY
100 Clayton St., Boston 22, Mass.

the first Issue ready this Fall . . .

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author

TALITARIAN. — *n.* One who
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au-thor'i-ta'tive (ô-thôr'i-tā'ti
from, authority; entitled to ob
thoritative teachings. 2. Ha
peremptory. — au-thor'i-ta'tiv
au-thor'i-ty (ô-thôr'i-ti), *n.*; *p.*
auctoritas.] 1. Legal or righ
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particular field; as, the Fort
HAS MORE ENGINEERS hand; —
ON ITS ony; witness. b A prec
PUBLISHING STAFF thor. d Just
influence of
THAN ALL OTHER like. — Syn.
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commission; as, author
TECHNICAL PUBLICATIONS act.
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a'thor-ized (ô'thêr-izd), *adj.*
hority. • b Sanctioned or appro

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McGraw-Hill Building,
New York 36, N. Y.
Published every other monday for Chemical Engineers in all functions

LITERATURE . . .

Filters.....All are characterized by high filtrate-clarity, rapid cleaning, high flow rates, and long filter cycles. Details in illustrated catalog.
R277 *Hercules Filter Corp.

Gas Absorber.....washers are extremely efficient air pollution control units capable of collecting acid mists & inert particulate material. Bulletin AP-125 for details.
130 *Buffalo Forge Co.

Hydrator.....The Super-D-Hydrator offers capacities from a few hundred lbs./hr. to 25 tons/hr., depending on characteristics of slurry. Bulletin 1286.
135b *The Sharples Corp.

Inert Gas Generators.....stand up under the toughest conditions, yet produce with complete dependability. Complete information in Bulletin I-10.
66 *The C. M. Kemp Mfg. Co.

Jaw Crusher.....Cast steel frame, antifriction side bearings & bumper bearings. Manganese steel jaw and check plates. Bulletin C12-B12 available on request.
278d *Denver Equipment Co.

Lip Seal.....provides a flow control for liquid injection in stuffing boxes. Composed of two parts. Additional information in Bulletin No. 491 CE. Send for your copy.
TL285 *Durametallic Corp.

Mills.....Complete information on "Jet-O-Mizer" Mills, "Jet-O-Clone" Dust Collectors, and testing and grinding services that are available.
246 *Fluid Energy Processing & Equip.

Mills Roller.....are engineered for automatic, uniform fine grinding. Feature whizzer air separation, pneumatic feed control and are self-lubricating. Catalog No. 79.
172 *Combustion Engr., Raymond Div.

Mixers.....Dispersator mixers with the patented "Micro-Shear" head feature: double shearing, balanced operation at much higher speeds than conventional mixers, etc.
R231 *Premier Mill Corp.

Mixers.....Bulletin 581 on the Multiaction Mixer and a Technical Paper #60 on Grease Mixer Design is now available on request. Offer increased production.
133 *Struthers Wells Corp.

Process Equipment.....“Sub-A” Flotation is available in sizes from 16” x 16” to 72” x 72”. “Cell-to-Cell”, “Free-Flow”, and Type “M”. Bulletin F10-B86.
278f *Denver Equipment Co.

Process Equipment.....Details on methods & equipment such as liquid vapor separators & wet and dry-type dust scrubbers or gas filters for tough separation problems.
R259 *Peerless Mfg. Co.

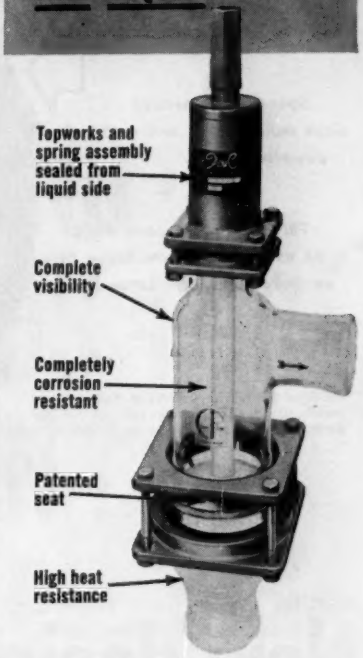
Processing Equipment.....Nine kinds of plastic & rubber pipe, plus pumps, valves, tanks & special equipment solve any corrosion or contamination problem. Buls. 80A & CE-53.
239 *American Hard Rubber Co.

Processing Kettles.....Bulletin 600 contains information about processing kettles for reaction, agitation, heat transfer and distillation.
BL277 *Bethlehem Foundry & Machine Co.

*From advertisement, this issue

NEW

A “SEE-THROUGH” SAFETY-RELIEF VALVE THAT SEALS GASES AND LIQUIDS



A completely new concept in relief valve seat design plus*Pyrex & Teflon Construction for the added advantages of full visibility and corrosion resistance. Seat pressure is completely independent of spring load. Valve reseats after venting without labor or material cost of rupture disc replacement. Ideally suited for both pressure and vacuum relief. Seals against liquids and gases. Use with liquid lines, with reactors and vessels of all types. Available in other materials of construction. Ask us for Bulletin RV-1.

*T.M., Corning Glass Works

A NEW LINE OF CORROSION RESISTANT FILTERS

Permanent filter element offers maximum particle retention with very high flow rate. Porosity range, one to 100 microns. Use for sterilization, clarifying, polishing. Pyrex & Teflon construction for visibility and high temperature applications. Write for Bulletin FPT-2.

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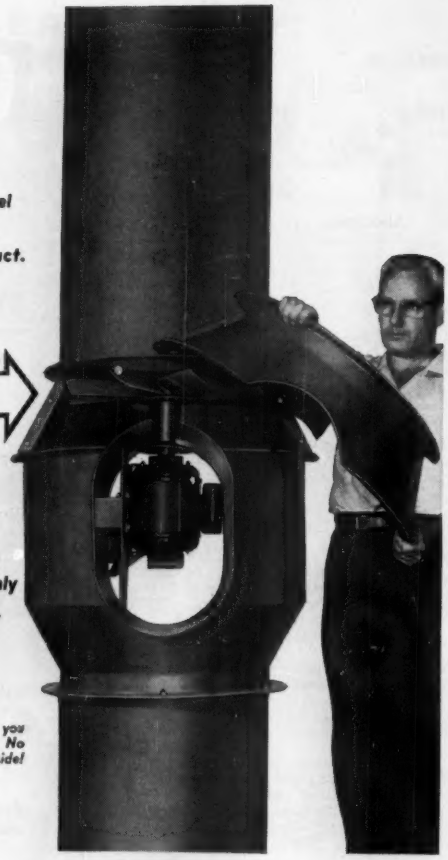

Now . . . pull the fan wheel or motor while DeBothezat® Bifurcator® Fan remains in duct.

Not just an access door. Half the entire cone comes off.

Speed up inspection . . . slash maintenance and downtime costs.

This removable cone design is an exclusive feature found only on DeBothezat Bifurcator Fans.

Published ratings on DeBothezat Fans tell you exactly what the complete fan unit puts out. No guess work — no allowance to be on safe side!

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East Moline, Illinois

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LITERATURE . . .

Purifiers.....Hi-ef prevent valuable particles from leaving evaporators & concentrators. Data on 13 types of purifiers, separators, mist extractors, scrubbers. Manual 803.
BL281 *The V. D. Anderson Co.

RDC.....combines many advantages such as high volumetric efficiency, high throughput capacity, elimination of interstage settling, etc. Bul. #T-1159.
160 *Gen. American Transportation

Reagent Feeders.....Both wet and dry feeders are available. Many standard units in stock. Complete information contained in Bulletin F6-B8.
278e *Denver Equip. Co.

Reversible Impactor.....features reversible rotation, wide open accessibility and interchangeable impact blocks. Sizes & models for your exact needs. Catalog.
127 *Williams Patent Crusher

Rotary Calciners.....Continuous combination rotary calciners and coolers are ideally suited for processing a wide variety of materials. Details in Bulletin No. 118.
142 *The C. O. Bartlett & Snow Co.

Samplers.....Continuous mechanical & automatic types for dry, solution or slurry sampling. Complete sampling plants & sample processing equipment. Bul. S1-B4.
278j *Denver Equipment Co.

Screens.....for efficient wet or dry screening. "True-Circle" eccentric action. Sizes to 6' x 14' in stock. Trommel Screens in sizes from 30" x 60" x 120". Bul. S3-B15.
278k *Denver Equipment Co.

Scrubber.....Flooded Disc Scrubber is completely adjustable. The flooded disc adjusts for cleaning efficiency over a wide range of operating conditions. Bul. 110.
144 *Research-Cottrell Inc.

Separator, Indox Grate Magnet.....is easily installed in any hopper or floor opening, chute or duct. Guards your product & plant against dangerous tramp iron. Bul. 1072C.
276a *Stearns Magnetic Products

Separator, Indox V Plate Magnet..... Powerful, uniform magnetic field traps iron particles in flowing materials in chutes, ducts, spouts, or on conveyors. Bul. 1074C.
276b *Stearns Magnetic Products

Separator, Indox V Magnetic Pulley .....can be installed at head of any belt conveyor system. Standard widths & diameters to match your present system. Bul. 1022C.
276c *Stearns Magnetic Products

Separator, Indox V Magnetic Drum..... is an ideal unit for process industries where granular materials are conveyed in enclosed chutes or spouts. Bul. 1052C.
276d *Stearns Magnetic Products

Sifters.....Ro-Ball sifters are available in a complete range of models & sizes, including stainless steel units to meet food & dairy sanitary codes. Ro-Ball Bulletin.
234 *The J. H. Day Co.

Spiral Rake Thickeners.....move settled materials to center in one revolution. Acid proof construction available. Further information in Bul T5-B6.
278e *Denver Equipment Co.

*From advertisement, this issue

WHAT HAPPENS WHEN A NATION SPENDS MORE ON GAMBLING THAN IT SPENDS FOR HIGHER EDUCATION?

If you can find any Romans around, ask them. They lived pretty high on the hog in their day. That is, until some serious-minded neighbors from up North moved in. The rest is ancient history.

You'd think their fate would have taught us a lesson.

Yet today we Americans spend twenty billion dollars a year for legalized gambling, while we spend a niggardly four-and-a-half billion for higher education. Think of it! Over four times as much! We also spend six-and-a-half billion dollars a year for tobacco, nine billion dollars for alcoholic beverages, and billions more on other non-essentials.

Can't we read the handwriting on the wall?

Our very survival depends on the ability of our colleges and universities to continue to turn out thinking men and women. Yet today many of these fine institutions are hard put to make ends meet. Faculty salaries, generally, are so low that qualified teachers are leaving the campus in alarming numbers for better-paying jobs elsewhere.

In the face of this frightening trend, experts estimate that by 1970 college applications will have doubled.

If we are to keep our place among the leading nations of the world, we must do something about this grim situation before it is too late. The tuition usually paid by a college student covers less than half the actual cost of his education. The balance must somehow be made up by the institution. To meet this deficit even the most heavily endowed colleges and universities have to depend upon the generosity of alumni and public spirited citizens. In other words, they depend upon *you.*

For the sake of our country and our children, won't you do your part? Support the college of your choice *today.* Help it to prepare to meet the challenge of tomorrow. The rewards will be greater than you think.

It's important for you to know what the impending college crisis means to you. Write for a free booklet to HIGHER EDUCATION, Box 36, Times Square Station, New York 36, New York.

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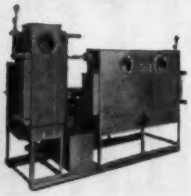

STERILE AIR

Now you can design spaces to maintain air sterility as scientifically as temperature and humidity. Only Kathabar enables you to deliver air at 5 micro-organisms per 10 cu. ft. or less, continuously.

FROST-FREE COOLING

Get continuous air supply at dry bulbs and dew points way down to –90 F. No freeze-ups... no fluctuating efficiency... no defrosting shutdowns... no duplicate sets of coils. Cool better; fewer tons. Proved in capsule-filling... photo film coating and chilling... cooling ammonium nitrate... environmental testing of chemicals and packages.

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Send facts on Kathabar systems for following application:

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name & title.....

company.....

street.....

city.....*zone*.....*state*.....

59-2C

LITERATURE . . .

Spray Nozzle.....“Cant-Clog” spray nozzle for air washers, cooling towers & spray equipment. Self-cleaning, installed in seconds. Ratings & Complete information.
R285 *Carrier Air Conditioning

Strainers.....Sizes from ¼” to 8”. Service 250 psi at 450 F. to 2500 psi at 1100 F. Types “Y” or Angle with screwed or socket-weld (flanged) connections. Bul. SS-21C.
126 *Strong, Carlisle & Hammond

Vacuum Drying.....Drying systems designed to meet your specific needs. From —60 F. to 400 F, & in capacities from a few lbs. to several tons. Booklet.
44-45 *F. J. Stokes Corp.

Pumps, Fans, Compressors

Compressors.....Integrated compressor units are available for handling all types of compressible fluids, within the pressure and flow limits of the machines. Information.
30-31 *Elliot Co.

Compressors.....Booklet “Compressors for Industry” describes Pennsylvania Compressors from 10 to 350 hp, horizontal, angle, and Oilfre models. Available now.
283 *Pennsylvania Pump & Compressor

Fan, Centrifugal.....The new airfoil centrifugal fan uses less than half the installed space of conventional centrifugal fans. Catalog will be available.
237 *Westinghouse, Sturtevant Div.

Pump.....SRL (Rubber Lined) pumps offer high efficiency, low horsepower. Sizes to 5000 g.p.m. Additional information in Bul. P9-B10 on request.
278i *Denver Equipment Co.

Pump.....The Model 3775, available in steel & any of the stainlesses, handles temp. to 600 F. because of its cooled support, bearing & seal chamber construction. Facts.
64a *Goulds Pumps, Inc.

Pump.....Fig. 3715 pumps handle latex with care. Normal cleaning operations are performed easily. Bulletin 725.4. contains complete information.
64b *Goulds Pumps, Inc.

Pump.....Hastelloy “C”, a highly corrosion-resistant nickel-chrome-molybdenum alloy is now available on Model 3604. Bulletin with performance chart & information.
64c *Goulds Pumps, Inc.

Pump.....The chemical positive displacement pump incorporates many outstanding features such as twin-balanced impellers, self-priming, etc. Catalog P 302.
240 *Waukesha Foundry Co.

Pump.....Full performance and dimensional information about Unipumps is contained in Bulletin No. 300. Available in capacities from 10 to 1700 g.p.m.
272 *The Weinman Pump Mfg. Co.

Pump, Diaphragm.....Stroke can be adjusted while pump is operating. Sizes 1” to 10” simplex and duplex, capacity to 1000 g.p.m. Bulletin P8-B12 offered.
278g *Denver Equipment Co.

*From advertisement, this issue

Pump, Metering.....Metriflow metering pumps in four standard sizes, up to 54 GPH, pressures to 300 psi. Complete information is available on request.
BL303 *The Madden Corp.

Pump, Vertical Centrifugal.....for handling frothy liquids or coarse, sandy slurries, constant or intermittent flow. Capacity to 450 gpm. Bulletin P10-B5.
278h *Denver Equipment Co.

Pumps.....Leakproof Electri-Cand pumps handle practically any clear liquid efficiently & safely. Feature removable cans. Literature is available.
97 *Allis-Chalmers

Pumps.....Durcopumps are available in fourteen alloys and special materials. Heads to 345 feet, capacities to 3500 gpm. Further information in Bul. P-4-100.
207 *The Duriron Co., Inc.

Pumps.....Type F centrifugal pump is supplied with a new rotary seal arrangement designated as model series FBL which replaces series FAL. Data in Catalog S-7253 CJ.
212 *National Carbon Co.

Pumps.....Heavy-Duty type made of stainless steel, monel, mild steel & other alloys can be operated up to 100% rated speed on thin liquids. Catalog MC.
TL259 *Viking Pump Co.

Pumps, Industrial.....Catalog E gives you complete information on Deming's extensive line of industrial pumps. This catalog is now available on request.
132 *The Deming Company

Pumps, Process.....Single & double stage models available . . . capacities to 5,000 GPM, heads to 1,900 feet, temperatures from —320 to 800 F. Complete line.
53 *Byron Jackson Pumps, Inc.

Services & Miscellaneous

Concrete Floor Maintenance.....Bulletin describes Radon 401 used to prevent "dusting" by penetrating surface and binding particles thereby retarding breakdown.
291A Maintenance, Inc.

Construction.....Information on low temperature or cryogenic installations. Also a copy of Bulletin G-48 "Refrigerated Storage Facilities" is available.
129 *Chicago Bridge & Iron Co.

Industrial Alcohol Regulations..... Final revised regulations on the distribution & use of Specially Denatured & Tax-Free Alcohols in Federal Register of June 29.
123-124a *U. S. Industrial Chemicals Co.

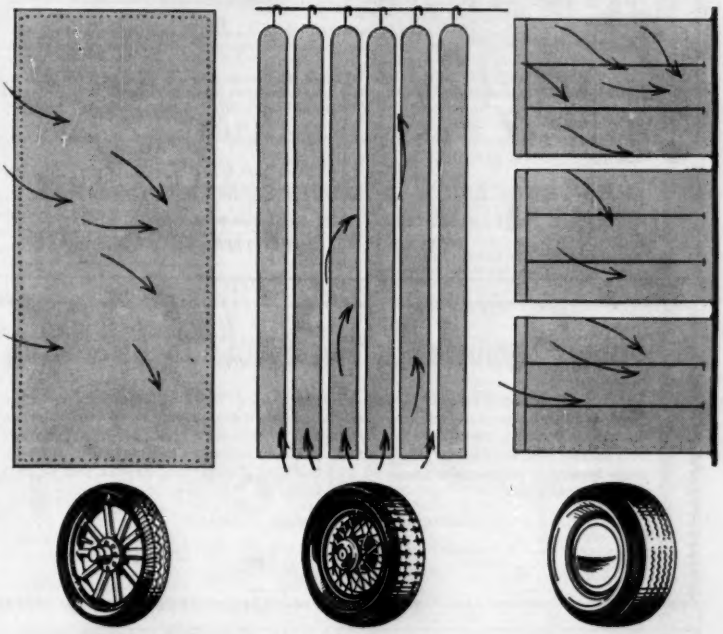
Maintenance Cleaning.....Sixteen fact-filled pages in a new booklet spell out the latest procedures for chemical cleaning of chemical soils. Bulletin No. F-10822.
279 *Oakite Products, Inc.

Packed Towers.....Reports from the continuing research into Packed Tower performance are available. Also a copy of Engineering Manual TA-40.
28-29 *U. S. Stoneware

* From advertisement, this issue

SINCE 1876 SLY

SLY DUST FILTERS For LONG BAG LIFE



1900's
SLY DUST ARRESTER

Cloth screens on wood frames were rigidly fastened to the dust arrester case, causing strain and excessive wear.

1930's
SLY TUBE-TYPE FILTER

Certain areas of cloth tubes, particularly around the cuffs, bore the brunt of incoming dust-laden air, leading to premature failure. Shaking device also contributed to wear.

TODAY NEW SLY "ROLL-CLEAN" DYNACLONE®

"Resist-O-Wear" filter bags have 3-section design for greater strength. Spacer weight is distributed on 3 seams. Bags are cleaned by reverse air.

New Dynaclone Filter Bags Provide 2 to 3 Times Longer Life

New Sly "Resist-O-Wear" bags (patent pending) far outlast other types, as proved on the most demanding applications. In addition to basic bag strength, Dynaclone construction and low-velocity design insures even distribution of dust-laden air over the entire cloth area . . . there is no dust concentration at certain points. Dust is removed automatically by reverse cleaning air — no shaking, no abrasion.

The Dynaclone operates continuously, 24 hours a day if required. Uniform, constant suction at dust sources results in complete dust collection.

Sly Dust Filters provide 20 to 40% more cloth in a given space than any other type. Space saved means lower installation costs, simplified piping and ductwork.

There are more than 40,000 Sly Dust Filters in use, including over 1,000 Dynaclones. Investigate their advantages on your applications...

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These assignments are of a non-military nature at our Florida and Southwestern U. S. locations. Personal interviews will be arranged on location for all qualified personnel. Please submit a complete resume, including salary requirements to

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Send resume and salary requirements to Manager or Technical Services.
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TEFLON*

Teflon*—experienced chemical engineer sought by important manufacturer of industrial hose, fittings, related products. Attractive New England location. Excellent laboratory and testing facilities. Growth situation with company projecting extensive use of Teflon* in future. Inquiries handled in complete confidence by established professional executive recruiting firm.

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P-5186,, Chemical Engineering
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Operating Manager Wanted: Evaporated salt plant in south wants experienced superintendent to manage operation. Work record required to show ability to manage plant and handle people. Opportunity for right person. P-5216, Chemical Engineering.

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Equipment Searchlight

CE's Searchlight spots the big bargains in used, resale and rental equipment.

Check this issue's listings—most complete in the field—for items you need now

COMPRESSORS

No better values at any price

74 CFM 1500 PSI 6¼-3¾-1¾x7 CP, TCB3
104 CFM 2500 PSI 6¾-4½-1-11/16x9 IR-ES3
110 CFM 3000 PSI Ing. GC 50BW
138 CFM 100 PSI 7x7, Ing. ES, CP & Joy
151 CFM 3000 PSI 13¾x12 Norwalk TRS-4T
208 CFM 100 PSI 9x9 Ing. Worth. CP
311 CFM 1500 PSI 10½-7⅞-3½x13 IR-ES3
351 CFM 350 PSI 11-5x11 CP TCB-2
364 CFM 100 PSI 10x9 Joy WG 9
465 CFM 100 PSI 12x11-IR-ES CP.T. Worth HB
660 CFM 125 PSI 11½-7x7 Joy Wn 102
676 CFM 125 PSI 15-9¼x12 IR-XCB
686 CFM 100 PSI 14x13 Ing. ES-Chic. P.T.
877 CFM 125 PSI 17-10½x14 IR. XRB
1665 CFM (actual) 100 PSI C300-300H Fuller
1721 CFM 110 PSI 23-14x16 Ing. PRE2
2950 CFM 100 PSI 19x30x30x19x24 Ing. XPV

AMERICAN AIR COMPRESSOR CORP.
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CIRCLE A ON READER SERVICE CARD

FOR SALE

Reaction kettles Synthetic Resin Units

1—18,000 lb. charge stainless with agitator coils, condensers, etc. including new "Selas" gas heating unit. 1—18,000 lb. charge stainless with agitator coils, condensers, etc. heated by a "Trent" electric jacket.

1—10,000 lb. charge stainless with agitator coils, condensers, receiver etc. jacketed for "Arochlor" electric heater. All kettles in equal to new condition and being replaced by larger units by new resin manufacturer.

Write

FS-4920, Chemical Engineering
Class. Adv. Div., P.O. Box 12, N.Y. 36, N.Y.

CIRCLE B ON READER SERVICE CARD

Equipment Wanted

DRYER—Continuous Apron Conveyor type. Total drying area approx. 250 sq. ft. Apron construction, stainless steel.
HAMMER MILL—#3 Mikro or equivalent.
MIXER—Double arm, blade tilting type. 300 gal. working capacity. Steam jacketed. 40 H.P. Stainless steel construction.
ROTARY AIR LOCKS—8"—12".
BALL MILL—6' x 10' Jacketed. Chrome Manganese Steel.
STAINLESS REACTOR—Min. size 6'6" x 8'. Must be built for 100 PSI pressure.
3 STAINLESS STEEL CONDENSORS—200 to 400 sq. ft. of tube surface.

Please include price information with full particulars in the first letter. Indicate if you own the equipment and where it is available for inspection.

W-4919, Chemical Engineering
Class. Adv. Div., P.O. Box 12, N.Y. 36, N.Y.

CIRCLE C ON READER SERVICE CARD

WANTED

8' x 150' USED ROTARY LIME KILN

W-5176, Chemical Engineering
Class. Adv. Div., P.O. Box 12, N.Y. 36, N.Y.

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Mill Equip: (3) Raymond 4-roller hi-side mills; Allis Chalmers 5 ft. dia. Ball Mill; Bucket Elevators; Conveyors; Storage Bins to 170 tons.
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$450,000.00 Gages and Meters with fully equipped Laboratory, Vacuum Gauges, Potentionmeters, Mercury Manometers, etc.
$500,000.00 NEW Supplies, Parts, etc., including 50,000 lbs. Stainless Steel 310 Welding Rod, etc.
MISCELLANEOUS EQUIPMENT: (195) Kinney Hi-Vacuum Pumps; (60) Stokes Rotary Pumps; High Line Dumping System; 400,000 lbs. NEW Steel Shapes and Plate, Foundry, Machine Shop, Handling Equip., etc.

MANTECA, CALIF. 80 - ACRE INDUSTRIAL PROPERTY AUCTION
MONDAY, SEPTEMBER 26th, 1 P.M.
All or in parcels, 300,000 ft. Buildings; 26 acres fenced; R. R. spur; near port, rail, truck, air terminals. Every facility for mfg., warehousing, storage, etc. Broker co-op. invited.

—SEND FOR FREE CIRCULAR—

MAX ROUSE AND SONS
361 S. Robertson
OL. 5-9300

TAUBER-ARONS COMPANY
8913 W. Olympic
OL. 5-9170

BEVERLY HILLS, CALIF. — Auctioneers

CIRCLE E ON READER SERVICE CARD

FOR SALE

BAKER PERKINS MIXER

"Unidor" Type-Size 14 DUM
Working Capacity—5 Cu. Ft.
GLOBE TRADING COMPANY
1815 Franklin St. Detroit 7, Mich.

CIRCLE F ON READER SERVICE CARD

CIRCLE G ON READER SERVICE CARD

BRILL FOR VALUES

CENTRIFUGES

Sharples C-20 and C-27 Super-D-Hydrator, 316 S.S.
Bird 18"x28", Solid Bowl, Continuous, 304 S.S.
Bird 32" x 50", Solid Bowl, Continuous, 316 S.S.
Sharples PY14, PN14 Super-D-Canters 316 S.S.
Tolhurst 26" susp. Rubber Imperforate Basket.
Fletcher 48" Suspended 316 S.S. Perforated Basket.
Sharples #16, 304 S.S., 3 HP motor.

REACTORS, EVAPS, ETC.

2—Glascote 750 gal. glass lined jacketed Reactors.
1—1200 gal. S.S. Jacketed Kettle.
650 gal. 304 S.S. Reactor with 100 sq. ft. Bayonet Heater.
1400 gal. Blaw-Knox, steel, jacketed, agitated Reactor.
1—700 sq. ft. Buflovak 304 SS Forced Circulation Evaporator
550 sq. ft. Buflovak monel single effect Evaporator
7500 gal. 316 S.S. Vert. Storage Tank, 7'x25', 50 psi.
750 gal. nickel clad Mixing Tank, 125# nickel coils.
500 gal. 304 S.S. Mixing Tank with nickel coils.
6—7,500, 6,000 and 2,000 gal. Rubber Lined Tanks.
4000 gal. Haveg Vert. Tank 8'x12'.
7500 gal. Rubber Lined Tanks 10'x13'.
1500 gal. Stainless Pressure Tank, 5'x10', 90#.
12,000 gal. horiz. steel Pressure Tank, 7'6"x36', 200 psi.
Stainless Heat Exchangers; 1220, 786, 536, 370, 315, 250 sq. ft.
Falls Industries 100 sq. ft. Karbate Condensor.
24" dia. x 35', 304 S.S. Bubble Cap Column.

FILTERS

#5 Sweetland Filter 304 S.S. 120 sq. ft.
Oliver 6' dia. Horizontal Filter, 316 S.S.
Oliver 5' x 6' Steel Rotary Vacuum Precoat Filter.
U.S. 200 sq. ft. 304 S.S. Auto-Jet Filter.
Oliver 5'3"x8' Steel Rotary Vacuum, vaportite housing.
Oliver 3' x 2' 347 S.S. Rotary Vacuum Filter.
Feinc 5'x6' Stainless Steel Rotary Vacuum Filter.
#10 Sweetland Filters, 27 leaves, 4" centers, 250 sq. ft.

DRYERS

Buflovak Vacuum Shelf with 20—60"x80" shelves.
1—4' dia. 304 SS Spray Dryer.
Devine Vacuum Shelf with 19—59"x78" shelves.
Devine Vacuum Shelf with 10—40"x43" shelves.
Buflovak 42"x120", atmospheric double drum Dryers, complete.
Devine 4'x9', single drum, atmospheric.
Buflovak 3'x10' Rotary Vacuum Dryer.
Baker Perkins 5'6"x6" Rotary Vacuum Dryer.
Buflovak 5' x 30', 3' x 7'6" Rotary Vacuum Dryers 316 S.S.
Louisville Rotary Steam Tube 6'x25', 6'x50'.
Louisville 8'x50' Stainless Steel lined Rotary Dryers.
Rotary Dryers 34"x30', 4'x40', 6'x50', 6'x60', 7'x80', 8'x87'.
Traylor 30"x18' Stainless Steel Rotary Dryer.
Link Belt, 7'5"x25', 6'4"x24", S.S. Louvre Dryers.
Atmos. Tray Dryers, 16 shelves, 40"x24".
P&S 10' wide Apron Conveyor Dryer 48' long.

MIXERS

1—Farrell-Birmingham "Midget" Banbury Mixer.
Day Imperial 150 gal. Jktd. double arm.
Baker Perkins 100 gal., jacketed, double arm, 30 HP.
Baker Perkins #16TRM, 150 gal. Jktd., Vac. 60 HP.
Baker Perkins 50 gal. jacketed, double arm.
Baker Perkins 10 gal. Jacketed 304 SS double arm.
Day "Cincinnatus" double arm, 250 and 100 gal.
Steel jacketed Powder Mixers, 225 and 350 cu. ft.
Patterson 6' dia. Conical Blender 15 HP.
3' dia. Simpson Intensive Mixer.

MISCELLANEOUS

Farrel Birmingham, 8" x 16", 2 Roll Chrome Plated Mill.
ISH, ISI Mikro, Pulverizers, 3 HP.
Abbe 2½'x3' porcelain lined Pebble Mill XP motor.
1—Raymond 10' dia. Single Whizzer Separator.
Raymond 10' dia. Single with Separator.
#5 Mikro Atomizer with motor and cyclone.
Bantam Mikro Pulverizers, S.S.
No. 1 Ball & Jewell Rotary Cutter.
#18 Cumberland Rotary Cutter.
Swenson Walker Continuous Crystallizers, 24"x30' sections.
#24 Rotex Sifter, 20" x 64", Quadruple deck.
#22 Rotex Sifter 40" x 56" double deck.
#81 Day Roball Sifter 40" x 120" single deck.
Chlorimet, Durimet and Duriron Centrifugal Pumps 1½" to 6".

Partial List — Send for Complete Circular
Ask About Our Rebuilding Services
TEXAS OFFICE: 4101 San Jacinto Street, Houston 4, Texas — Tel.: JAckson 6-1351

BRILL EQUIPMENT CO.
35-61 Jabez St., Newark 5, N.J.
Tel.: MArket 3-7420

CIRCLE H ON READER SERVICE CARD

CHEMICAL EQUIPMENT DIVISION

Briquetting Presses 27"x23" & 30"x24"
Sharples C20&27 Centrifuges Stainless
40" Centerslung Centrifuge STAINLESS
40" Centrifuge Steel Susp. Perf.
10"x10'5" HASTALLOY Column
6'x27' Column—NI-CLAD
6'x29' Column SS347—20 Tray
12"—3 Roll Laboratory Calendar
6700CFM 100Psi Air Compressor 1250HP
387CFM 100PSI Air Compressor 75HP
142CFM 100PSI Air Compressor 25HP
1000 sq. ft. Stainless Heat Exchanger
1865 sq. ft. 316SS Heat Exchanger
Robinson Size 1630 Rotary Cutter
18 Shelf Buflovak Vac. Dryer 42"x42"
Stokes A832 Tray Dryers
6' Stainless Double Effect Evaporator
30"x30" Filterpress 3 eye closed
5'3"x3' Oliver STAINLESS Precoat Rotary Vacuum Filter
4'x1' Bird Young STAINLESS Rotary Vacuum Filter
195 sq. ft. Industrial Filter STAINLESS
Sweetland Filters #7 and #12
Petro Chem Furnaces, 9; 7; 2MM/BTU

PARTIAL LIST ONLY
Send us your specific requirements

Rotary Kilns: 8'x60'; 8'x115'; 7'x45' 7'x120'; 6'x124'
Rotary Dryers: STAINLESS 8'x80'; 4'x25' Steel 8'8"x70'; 7'x50'; 4'x47'; 4'x30' Steam Tube 6'x50'; 6'x25'; MONEL Steam Tube 54"x35'
Roto-Louvre Dryers: 502-16; 705-24 STAINLESS 604-24; 310-16; 207-10
6' Buflovak Pan Dryers, Jktd.
Kettle Stainless Jktd. 200; 100; 75 Gal.
#5057 Raymond 5 Roll Hi-Side Mill
#3036 Raymond 3 Roll Hi-Side Mill
#5060 Dixie Mogul Hammermill
Bartlett & Snow #2 Pulverizer
Raymond 00 & 0000 Impact Mill's
Mikro 2TH Pulverizer
8'x11' Traylor Ball Mill
Stokes DDS2 & BB2 Tablet Presses
30 gal. Jkt. Stainless Reactor 1000 PSI
700 gal. NEW Autoclaves—Jacketed
750 gal. Steel Jacketed Reactor NEW
1500 gal. Jacketed-Agitated Autoclave
2500 gal. HASTALLOY Reactor
3000 gal. STAINLESS Resin Kettle
30" Raymond Double Whizzer
16' Sturtevant Air Separator
60"x84" Rotex Screen STAINLESS
40"x84", 30"x96" Roball Screens SS
Stainless Vac. Receivers 50; 75; 100 gal.

SEND US YOUR SURPLUS LISTS

HEAT & POWER CO. INC.
60 E. 42nd St., New York 17, N. Y.
310 Thompson Bldg., Tulsa 3, Okla.

CIRCLE J ON READER SERVICE CARD

LOEB OFFERINGS

Autoclave: 50 gal. Struthers Wells, st. st.
Centrifugal: Tolhurst 20" st. steel (New).
Centrifugal: AT&M 60" st. st. perf.
Dewaterers: Davenport 3A, bronze hd. 3 hp.
Disintegrator: Rietz RD18P, 75 hp.
Dryers: Devine 2 x 4' vac. drum, st. steel.
Dryer: Bowen lab. spray, st. steel.
Dryer: American atmospheric 24 x 48".
Dryer: Devine #7 13-shelf 60" x 7'.
Dryer: Stokes vac. shelf 22—44x40".
Evaporator: Buflovak st. st., 94 sq. ft.
Filter: Sweetland #5 st. st. lined.
Filter: Oliver precoat 12 x 2" st. steel.
Filter: Eimco st. st. drum 16" x 12".
Filter Press: Shriver 24" St. steel.
Separator: Sweco model G-ID-3 st. steel.
Homogenizers-Dispenser: Tri-Homo #10, #4.
Kettles: st. steel with and without ag.
Dopp 150 gal. dbl. act. agitator.
Mills: Mikro Atomizer 5MA, st. steel.
Day 3-roll high speed 14 x 30".
Mixers: Dbl. and sgl. arms sigma blade.
Dry Powder, various sizes.
Pumps: Rotary, gear, centrif., vacuum.
Screen: Rotex model 41 st. steel.
Tablet Press: Stokes DD2, 23 station.
Vacuum Pans: 42" and 72" stain. steel.

LOEB EQUIPMENT SUPPLY CO.
820 WEST SUPERIOR ST. CHICAGO 22, ILLINOIS

CIRCLE K ON READER SERVICE CARD

AGITATOR—S/S w/10 HP xpl. proof 2 spd motor, 3" shaft x 6' long w/propeller—1 HP Lightnin' 1150 RPM

SCREENS—12" x 72" S/S Ajax—20 x 84, 20 x 96 Rotex—3 x 5, 3 x 10 Tyler Hummer

FEEDERS—S/S Vibrating 4½ x 24, 24 x 72 Syntron—Hardinge B Constant Weight

MILLS PULVERIZING—3 HP Sturtevant 00—10 HP Mikro 2 TH—30 HP Raymond—50 HP Mikro 3 TH w/Mikro Collector (unused)—100 HP Jeffrey 36 x 42—250 HP non-clog—450 HP Penna. SXT 14.

DRYERS, ROTARY—24" x 22', 3' x 24', 4' x 40', 5' x 50', 6' x 30', 7' x 58' all w/motor drives

DRYER, VACUUM SHELF—w/13 shelves 59" x 78", total area 356 sq. ft.

BRIQUETTING MACHINE—Komarek Greaves, 11/16 x 4-5/16 x ¼" dies w/feeder, motors, etc.

LAWLER COMPANY

Durham Ave. Liberty 9-0245 Metuchen, N. J.

CIRCLE L ON READER SERVICE CARD

BEST BUY

SPECIAL RAYMOND MILL
#1 Automatic Pulverizer
Complete with Raymond 5'6" diameter Double Whizzer Separator.
Priced To Sell

ME MACHINERY AND EQUIPMENT CO.
123 Townsend St. · San Francisco 7, Calif.

CIRCLE N ON READER SERVICE CARD

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For Every Business Want

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CHEMICAL PLANT EQUIPMENT

Located: Clearwater, South Carolina

Salesman on Location
Phone LY 3-3892

SEPARATORS
1—High tension, Carpco, HS-218.
1—High tension, Carpco, HS-418.
4—High tension, Carpco, HT-460.
6—Magnetic Carpco, MI-418.

DREDGE
1—6 cu. ft. Yuba bucket.
1—Screening-Dewatering & Stacking Plant.

CLASSIFIERS
1—Akins Spiral 24" dia. 15' long.
2—Carpco Dewatering Spiral DS-12 12" x 8'.

CONCENTRATORS
1—Double fan Carpco FC-2924.
1—Single fan Carpco FC-1924.

CONVEYORS
1—30" belt, 51'-0". Steel Frame.
7—Sliding belt type; 6" Model BC-68, 12'-3" to 43'-1".

ELEVATORS
1—Elevator, 22'-6" centers, 3" x 3" Buckets.
1—Elevator, 23'-6" centers, 3" x 3" Buckets.
1—Elevator, 26'-0" centers, 3" x 3" Buckets.
1—Elevator, 29'-1" centers, 3" x 3" Buckets.
4—Elevators, 24'-6" centers, 3" x 3" Buckets.
1—Elevator, 29'-8" centers, 3" x 3" Buckets.
1—Elevator, 26'-7" centers, 3" x 3" Buckets.
3—Elevators, 34'-6" centers, 6" x 4" Buckets.
2—Elevators, 26'-2" centers, 6" x 4" Buckets.

FEEDERS
1—Schaffer 20" x 6' Automatic.
1—Carpco RT—50, Rotary with 20 yd. Bin.

JIGS
1—Pan American Placer type PE Single cell, 12" x 12".
1—Pan American six cell, 10" x 10".
1—Yuba Mineral, model J-1, 2 cell, 24" x 24". 1 HP.
14—Yuba, 4-cell, 42" x 42".

KILN
1—Ruggles-Cole Hardinge XL-2, 48" dia. X 30' long.

SCREENS
2—Allis Chalmers low head, single deck, 6' x 12'.
1—12" x 24" Allis Chalmers, Single Deck.
1—Vibrating, Tyler Hummer, type 88, 4' x 8'.

WRITE *HU 4-7601* *WIRE*

MACHINERY CENTER, Inc.
1201 W. 6th West, Salt Lake City 10, Utah

CIRCLE O ON READER SERVICE CARD

2 colloid Mills 40 HP EX. PR.
Dowtherm 225 KW
Stokes R Tablet
50 gal. S.S. Autoclave 2000 lbs. pressure
3½ gal. S.S. Autoclave 2000 lbs. pressure
Vukanizer 60" x 9' 125 lbs.
Sweetland #2 all stainless
Stainless steel Ball Mill
Proctor & Schwartz finned drum driers

MACHINECRAFT CORPORATION
800 Wilson Ave. (East of Doremus)
Newark 5, N. J. Mi 2-7634

CIRCLE P ON READER SERVICE CARD

BARGAINS GALORE!

5—Rotex Screens 30" x 96"; 40" x 84"; 60" x 84".
1—Jeffrey Traylor S. S. Screen 30" x 68".
3—Spiral Blenders 1000# to 3000# Capacity.
1—Raymond #3036 High Side Mill.
1—Raymond 36" Whizzer Separator.
1—Rotocione Size 16, Type W.
1—Sturtevant 2" x 6" Open Dr. Lab. Crusher 5 H.P.
1—Patterson 5' x 6' Jack. Ball Mill 20 H.P.
1—Abbe 50 Gal. Porc. Lined Mill, M.D.
1—Autoclave 1000 psi, 30 Gals., S. S.
1—Cyclotherm Boiler 620# hr., @ 250 psi.
5—Hercules Type 316 S.S. Filters 8" & 16" square.
Conveyors, Labelers, Agitators, etc.

We buy your surplus. Send us your inquiries.

THE MACHINERY & EQUIPMENT CO.
Used Div. HARING EQUIPMENT CORP.
91-93 New Jersey R.R. Ave., Newark 5, N. J.
Market 2-3103

CIRCLE Q ON READER SERVICE CARD

SOLVE YOUR PRODUCTION PROBLEMS WITH TESTED REBUILT EQUIPMENT

FIRST MACHINERY FEATURED SPECIAL

STAINLESS STEEL FILTER PRESS

9 Chambers; 12" x 12"
1" Frames; 15 sq. ft. area
⅝" cu. ft. cake capacity
Manufacturers List $1200
First Machinery Price
First Come—First Served **$550.**

2 MONEL REACTORS; 2800 Gal. 6'8" x 13'; 175# ASME Jktd. & Internal.
Struthers Wells Stainless Drum Dryers; 5' x 10' and 5' x 4' Complete.
Sparklar Stainless Steel, Lithcote Lined Filter; 500 sq. ft.
Ames 300 HP Automatic Boiler; ASME 1956; No. 6 Oil Fired.
Struthers Wells Type 316 Stainless Steel Jktd. & Agt. Reactors 2000 Gal.
Stainless Steel Heavy Duty Pressure Tanks; 850 Gal. with Agitators.
9 Devine Vacuum Chamber Dryers from Lab. Size to No. 36 Double Door.
Patterson-Kelley Stainless Steel Twin Cone Blenders; 30-150 cu. ft.

DRYERS and EVAPORATORS

Stainless Lined Rotary Dryer; 50" x 20'; Stokes Rot. Jktd. 34" x 10'.
Double Drum Dryers by Buffalo & other makers 28" x 60" to 40" x 120".
Zaremba Double Effect INCONEL Evaporator with Calandria; 430 sq. ft.
Stainless Lined Rotary Counter Current Atmos. Dryer 50" x 20'.
Pittsburgh Lectro Dryers; Models BAC Size 25; BWC Size 3500.
Bowen Stainless Steel Laboratory Spray Dryer; 30" x 32".
Multi Pass Jacketed 12" Screw Conveyor; 4 Sections 10' S/S Troughs.

REACTORS and PRESSURE VESSELS

Nickel Clad Reactor; 7' x 11'6"; Manhole; Jacketed and Agitated.
Lancaster Stainless Lined Rotary Reactor; 50' x 17'4"; Jktd.; 300 PSI.
Mojonnier Stainless Steel Vacuum Pans; 3' x 10'; 6' x 12'.
3 Stainless Steel Vertical Pressure Vessels 42" x 10'; Dished Heads.

FILTERS and FILTER PRESSES

Shriver and Sperry Filter Presses to 42" Cast Iron, Stainless, Ni-Resist, Aluminum.
Oliver Continuous Rotary Panel Type Vacuum Filters; 8' x 8' and 8' x 10'.
Feinc String Type Rotary Vacuum Filters 6' x 6' & 8' x 10'; Stainless contacts.
Bird Young Rotary Vacuum Filter, 4' x 4'. Sweetland Pressure Filters No. 2 to 12.
Enzinger Vertical Stainless Pressure Filter; 18" x 26"; ASME; 24 sq. ft.
Stainless Nutsche Type Filter 6' dia. x 2'. Bowser Filter w/Pump; 2000 GPH; 69 sq. ft.
Enzinger Leaf Type Filter; 48" x 57" Tank with 15 leaves; 360 sq. ft. surface.

MILLS — GRINDERS — PULVERIZERS

Abbe Jacketed Steel Ball Mills, 42" x 36" with charge of balls.
International Porcelain Lined, Ball Mill 8' x 8'; 50 HP Motor.
Patterson Jacketed Ball Mill, 54" x 42"; good for Vacuum.
Mikro Pulverizers; up to No. 4's. Mikro SS Atomizers Model 5 & 6.
Fitzpatrick Comminuting Mills, Stainless Steel; Models C, D, K.
Williams Hammer Mills to 16" x 48". Raymond Imp Mills; many models.
Williams Ring Roll Lab Mills, 3 Roll. 10" x 3"; complete.
American Ring Roll Crusher with 30" x 33" Throat 50 HP Motor.

RECENT DESIRABLE ADDITIONS TO THE FMC STOCK

Glass Lined Jacketed REACTORS; 50-60-100 gal. to 500 gal.
2 Stainless Steel 30" MICRONIZERS complete with accessories.
Sprout Waldron Rotary Cutter Model 1SB; 15 HP Motor.
Feinc Stainless Steel Rotary Vac. Filter 3' x 1'; String Dis.
Laboratory STAINLESS Drum Dryer with Scraper; 8½" x 11½".

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FIRST MACHINERY CORP.

209-289 TENTH STREET, BROOKLYN 15, N. Y.
PARKING ON THE PREMISES
PHONE: STerling 8-4672

CIRCLE R ON READER SERVICE CARD

FOR "IMPOSSIBLE" BUDGETS

2—Tolhurst 48" x 24" perf. susp. basket Centrifugals. S.S. contact, late type Ex prf 2 speed Mtrs. Each $4500.00

1—Louisville Rotary Steam Tube Dryers, 54" dia x 35'. All monel contact parts. 1100 sq ft ASME 150# Nat Bd. New 1954. Used less than 1 year. New Price $43,000.00. Our Price, $14,750.00

1—Raymond #50 Imp Mill, with new hammers & Fan. In excellent condition. Price, $3750.00

Wire or phone collect—GA 1-1380

MACHINERY AND EQUIPMENT COMPANY
123 Townsend St. San Francisco 7, California

CIRCLE S ON READER SERVICE CARD

MODERN REBUILT MACHINERY

UNION Rebuilt Machinery Established 1912

Baker Perkins, Day, W. & P. Heavy Duty Mixers, 2½ to 150 gal. caps., Jacketed and Unjacketed.
Stokes 90-D Automatic Stainless Steel Tube Filler and Closer.
Pneumatic Scale High Speed Automatic Cartoning Line with Feeder, Bottom Sealer, Top Sealer, Wax Liner, Interconnecting conveyors.
Standard Knapp, A-B-C, Ferguson and Ceco Case Sealers.
WRAPPERS: Package Machinery, Hayssen, Battle Creek, Scandia, Wrap-King, all sizes and models.
Stokes Model DD-2 Rotary Tablet Machine. Also Models R and RB-2.
Werner & Pfleiderer 3,000 gal. and 3,500 gal. Jacketed Double Arm Mixers.
Day 50 gal. gearless Pony Mixer.
Colton 6 ft. Diam. Stainless Steel Pan.
Stokes & Smith Model G1, G2, HG84, HG87, and HG88 Auger Powder Fillers.
Raymond "O" Pulverizer.
Mikro Pulverizers, Bantam, 1SH, 2TH, 3TH and 4TH.
Fitzpatrick Comminuters.

Complete Details and Quotations Available on Request

UNION STANDARD EQUIPMENT CO.

318-322 Lafayette St. New York 12, N. Y. CAnal 6-5333
167 No. May St. Chicago 7, Illinois 5Eely 3-7845

CIRCLE T ON READER SERVICE CARD

DIESEL LOCOMOTIVES & CRANES

9 Gen. Elec. 20, 25, 45, 65, 80 & 100-Ton
25-Ton Industial Brownhoist, 60' Boom Crane

PLANT EQUIPMENT

4' Telsmith TY Gyratory Crusher
2—Wemco 2M-HMS Plants
No. 5000 Dixie Mogul Hammermill 500 HP
No. 1 Sturtevant Rotary Fine Reduction Crusher
72 x 28' Madison Rotary Dryer
F55 Syntron Grizzley Feeder
10—1½ & 2 Yd. V-Shape Dump Cars
2—5' x 8' KVS Air Swept Ball Tube Mills
Ball Mills: No. 56, 6' x 4', 6' x 9' & 7' x 22'
Hardinge Mills: 3'x8", 3'x24", 6'x48" & 10'x48"
Rod Mills: 4' x 11', 6' x 12' & 7' x 15'
Jaw Crushers: 10" x 28", 14" x 28", 15" x 24", 18" x 36", 30" x 36", 48" x 72"
Crushers, Fine Reduction: 22", 2', 3', 3½' 848 Cone, & 40" x 22" Roll
Rotary Dryers: 3'x30', 5'x30', 6'x70' & 8'x80'
Rotary Kilns: 36" x 30' 6" x 70' & 9' x 100'
Rote Louver #207-10 Types 316 SS, Link Belt
Louisville Monel Steam Tube Dryer, 54" x 35'
Laboratory Rotary Kiln, 36" x 30", Complete
4' x 10' Tyler-Hummer Electric Vibrating Screen
5' x 12' Seco Single Deck Vibrating Screen
6' x 16' Gayco Centrifugal Air Separator
24" x 95' Hewitt Robins NEW Truss Belt Conveyor
6—30" x 32" Dings Magnetic Head Pulleys
3—Inger.-Rand 2200 & 3051 CFM Compressors
2000 Tons Steel Sheet Piling, 10' to 78'
2—150 HP, 1—200 HP S.D. Elec. Hoists

WANT BUY DRYERS — KILNS — CRUSHERS

R. C. STANHOPE, INC.
60 E. 42nd St. New York 17, N. Y.
Tel. MU 2-3075

CIRCLE U ON READER SERVICE CARD

SPECIAL

BUFFALO 32" x 90" DOUBLE DRUM DRYER

SEND FOR LISTINGS

STEIN EQUIPMENT CO.
107—9th STREET BROOKLYN 15, N. Y.
Sterling 8-1944

CIRCLE V ON READER SERVICE CARD

OUTSTANDING VALUES!

40" rubber lined suspended centrifuge, perforated basket.
400 gal SS jack. & agit. reactor.
80 gal SS Autoclaves, 500 PSI.
Hersey 1½' x 16' hot air dryer.

CHEMICAL & PROCESS MACHINERY CORP.
50-52 9th St., Brooklyn 15, N.Y. HY-9-7200

CIRCLE W ON READER SERVICE CARD

PIPE

2,000,000 ft. 2".....3.50¢ to the foot
1,000,000 ft. 3".....7.70¢
1,000,000 ft. 4".....10.95¢
500,000 ft. 6".....19.80¢
200,000 ft. 8⅝".....28¢
400,000 ft. 10¾".....35¢
75,000 ft. 12¾".....40¢

PIPE

All No. 1 Grade Plain End and Cleaned

INDIANA-OHIO PIPE CO.
P.O. Box 5412 Sheperd Sta. Phone CL 3-5527
COLUMBUS 13, OHIO

CIRCLE X ON READER SERVICE CARD

2—100 H.P. Carrier Brine Chilling Units
3—Niagara #633 No frost Spray Coolers
2—60 H.P. G.E. Motors with Automatic reduced Voltage Controls
100 H.P. D.C. Motor, 230 Vts & Controls

JOHN F. CARSON
A & Venango Sts., Phila., 34, Pa.
GArfield 6-2221

CIRCLE Y ON READER SERVICE CARD

FOR SALE

JACKSON & CHURCH AUTOCLAVE

Vacuum Impregnator—Jacketed
54" x 72"—150,000 Cu. Inch
Almost New

GLOBE TRADING COMPANY
1815 Franklin St. Detroit 7, Mich.

CIRCLE Z ON READER SERVICE CARD

STAINLESS STEEL TANKS

24" x 45", 10 gauge, 400 PSI, type 304, ¼" pipe thread each end. *NEW*, $300 value, $99.50. Size 8½" x 18", 16 gauge, $14.50. Case of 8, $14.25. F.O.B. Baton Rouge, Louisiana.

Illinois Mfg. & Supply Co.
1829 S. State, Chicago 16, Illinois

CIRCLE AA ON READER SERVICE CARD

ECH SPECIAL

Abbe Eng. Jacketed 5' x 6' Ball Mill, chrome manganese steel. Price $2750.00.

EQUIPMENT CLEARING HOUSE, INC.
111 33 Street Brooklyn 32, N. Y.
SOuth 8-4451—4452—8782

CIRCLE BB ON READER SERVICE CARD

Searchlight Equipment Locating Service

This service is aimed at helping you the reader of "SEARCHLIGHT", to locate Surplus new and used equipment not currently advertised. (This service is for USER-BUYERS only.) No charge or obligation.

How to use: Check the dealer ads to see if what you want is not currently advertised. If not, send us the specifications of the equipment wanted on the coupon below, or on your own company letterhead to:

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Classified Advertising Division
Chemical Engineering
P.O. Box 12, N.Y. 36, N.Y.

Your requirements will be brought promptly to the attention of the equipment dealers advertising in this section. You will receive replies directly from them.

Searchlight Equipment
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Classified Advertising Division
CHEMICAL ENGINEERING
P.O. Box 12, N. Y. 36, N. Y.

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LIQUIDATING

$8,000,000 ALCOHOL PLANT

OMAHA, NEBRASKA

MAJOR ITEMS

PRESSURE LEAF FILTERS

1—Sparkler #33-S-17, T304 SS, 91 sq. ft., w/scavenger
1—Sparkler #33-S-7, T304 SS, 61.8 sq. ft., w/scavenger
2—Sweetland #12, (24)—36" dia. leaves, 336 sq. ft.
6—Shriver 48" C.I. P.&F. filter presses, 50, 48, & 40 chambers, hydraulic closure
1—Sperry 30" C.I. P.&F. filter press, 30 chambers.

EVAPORATORS—HEAT EXCHANGERS—STILLS

2—Quadruple-effect evaporators, calandria type, 4050 sq. ft., cast iron bodies & copper tubes. With 1230 sq. ft. horizontal copper preheaters, & 2450 sq. ft. finishing pans. Total 19,900 sq. ft. each evaporator.
7—Ansonia 691 sq. ft. horiz. Dbl. pipe coolers, copper tubes.
8—American 654 sq. ft. spiral steel heat exchangers.
18—Tubular heat exchangers, copper tubes, 1500, 1350, 1130, 637, 380, 290, 184, 176, 156 sq. ft.
2—Acme 96" dia. x 44' high copper beer-still columns, (20) perforated & (4) bubble cap trays.
5—Leader 96" dia. steel rectifying columns, 44' & 51' high, bubble cap trays.

DRYERS

12—Buflovak 42" x 120" double drum, ASME 160#
2—Bonnet 7' x 60' rotary hot-air, 5/8" shell
2—Bonnet 6' x 50' rotary hot-air, 5/16" shell
2—Davenport 6' x 30' rotary steam tube.

PRESSES

6—Davenport #2A dewatering presses
3—Davenport #1A dewatering presses
2—French Oil Extraction presses, 60 HP.

PULVERIZERS—GRINDERS

10—Forster hammermills, 25" x 33", 75 & 100 HP.
8—Nordyke & Marmon roller mills, 2-rolls; 10 x 36, 10 x 42
1—Stedman reversible hammermill, dbl. V-belt drive
4—Western "Bearcat" hammermills
2—Allis-Chalmers Interplane grinders.

SCALES

4—Wallace & Tiernan auto. bulk handling scales, elec. operated, capacity to 2000#/min.
4—Fairbanks tank scales, to 75,000# capacity
20—Scales, dial, beam, etc., all sizes. Also track scales, truck scales, etc.

MISCELLANEOUS

250—Steel pumps, 1" to 10", 1 HP to 150 HP.
200—Steel tanks & bins, all sizes & types.
100—Steel & stainless steel screw conveyors, to 161' long.
25—300 amp. welders, elec. & gasoline drive.
4—Lightnin' #SAG-2500 S.E. agit., 18" dia. prop., 25 HP TEFC motor.
9—Davenport 5' x 25' inclined "slop" dewatering screens.
2—DeLaval size 48" multi-matic separators.
8—Allis-Chalmers Degerminators.
6000 HP—TEFC motors, 3/60/220-440/, up to 150 HP.
20—Steam turbine, up to 150 HP.
2—Horiz. steel precookers, 6' 6" dia. x 25' long.

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Type 316 Stainless Steel Equipment

7—Alloy Fabricators Type 316 SS pressure vessels, 4500 gal., complete with agitators and drives, 45 psi.

2—Alloy Fabricators Type 316 SS, 4500 gal., jacketed reactors, complete with agitators and drives.
2—Alloy Fabricators Type 316 SS, 1000 gal., jacketed kettles, ⅜" material throughout.
12—Whitlock Type 316 SS pressure vessels with coils, 270 gals.
3—Whitlock Type 347 SS pressure vessels with coils, 300 gals.
3—Type 316 SS mixing tanks, 6000 gal., complete with agitators and drives.
8—Acme Type 347 SS settling tanks with cone bottoms, 1000 gal.
1—2600 gals. Type 316 SS vertical vacuum receiver.

3—Vertical Type 316 SS activated carbon absorbers, 5'4" dia. x 16'.

1—Struthers Wells 75 gal. Type 316 SS 500 lb. pressure vessel ASME code National Board.
2—Project fabricators type 316 SS vacuum receivers, 160 gals.
2—Pfaudler 500 gal., glass lined jacketed kettles.
1—Pfaudler 20 gal., glass lined vacuum receiver.
1—Haveg, 500 gal., vacuum receiver.
2—Aluminum horiz. 5000 gal. storage tanks.
5—Pfaudler horiz. glass lined storage tanks, 5000 gals.
1—Pfaudler vertical glass lined storage tank, 5000 gals.

4—Rubber lined horiz. storage tanks, 5000 gals., working pressure 45 lbs.
16—Rubber lined vertical storage tanks, 4500 gals., working pressure 45 lbs.

2—Rubber lined vertical storage tanks 2500 gals. working pressure 45 lbs.

11—Patterson-Kelley type 316 SS condensers, 75, 84 and 235 sq. ft.
4—Type 316 SS packed columns, 18" x 11'7½", working pressure 45 psi
2—Shriver 18" x 18" SS plate and frame filter presses, 10 chambers.
5—Shriver 42" x 42" wood plate and frame filter presses, complete with hydraulic closing device, 30 chambers.

7—Buflovak Type 316 SS jacketed rotary vacuum dryers, 5'x30', complete with 25 H.P. explosion proof motors and drives

3—Type 316 SS Ter-Meer continuous type centrifuges 4' dia. bowls complete with motors.
3—Readco stainless steel horizontal blenders, 450 cu. ft. working capacity, complete with 75 HP motors
3—Mikro model 3 TH stainless steel pulverizer, complete with 40 HP explosion proof motors
1—Mikro SS bantam pulverizer, model CF, complete with ¾ HP explosion proof motor.
3—Gruendler SS, lab size, pulverizers.
3—Nash, Model TS-12, vacuum pumps, with motors.
1—Stokes Type 316 SS, jacketed, rotary vacuum dryer, 2' x 3'.
14—Copper jacketed mixing kettles, 3500 gal. each.
14—Copper jacketed rotary vacuum dryers, 8 x 10.
5—American type 316 SS blower model MD, size 27".
1—Fuller Type 316 SS, airveying system.
1—Aldrich Groff type 316 SS hydraulic triplex pumps, size 2¾" x 4" at 500 PSI.
1—Quimby type 316 SS twin screw pump with 10 hp variable speed drive.
100—Stainless steel centrifugal pumps, all makes and sizes.
2—Powell type 316 10" hydraulically operated flanged and gate valves.
2—Tyler type 38 tandem SS Hum—mer screens, size 42" x 9'8".
3—Williams type 316 SS hammer mills with 100 HP motors.
3—150 gals. type 316 SS jacketed kettles.
3—200 gals. type 316 SS jacketed kettles.
12—Type 316 SS cyclone separators, 5'2" x 10'8" overall.
500 Tons of type 316 stainless steel pipe, fittings, and valves, ranging from 2" to 6".
500 Tons of structural steel.
50—Stainless steel and aluminum hoppers, all sizes.

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CHEMICAL PROCESS EQUIPMENT

1—Williams 4 roll Comet size mill, complete with all auxiliary equipment
1—General American 7' x 40' rotary dryer, ⅜" welded shell, complete
1—Sharples type 316 SS Super-D-Canter, Model PN-14.
1—AT&M type 316 SS suspended type centrifuge complete with 26" perforate basket, plow and motor

AUTOCLAVES, KETTLES AND REACTORS

2—Monel 2500 gal. jacketed autoclaves, 175# jacket, 175# internal pressure
1—Pfaudler 200 gal. glass lined jacketed reactor, complete with anchor type agitator and drive
1—Struthers Wells type 316 SS jacketed reactor, 2000 gal., complete with agitator and drive
1—Van Alst 250 gal. SS jacketed kettle, complete with SS column and condenser
2—Blaw-Knox 600 gal. steel reactors, complete with double motion agitators and drives, 50# jacket, 50# internal
1—18,000 gal. aluminum storage tank

DRYERS

2—American double drum dryers, 42" x 120", ASME N. B., complete with drives and motors
1—Hersey stainless steel rotary dryer, 3' x 16'
1—Allis Chalmers SS 6' x 50' rotary dryer, complete
10—Allis Chalmers rotary dryers, 6' x 50' and 7' x 60'
3—Link Belt steel roto louvre dryers, Model 207-10, 310-16, 604-20
1—Stokes Model 59DS steel rotary vacuum dryer, 5' x 30'
2—Louisville rotary dryers, 8' x 50', stainless steel
1—Buflovak SS jacketed rotary vacuum dryers, 3' x 15'
3—Buflovak steel jacketed rotary dryers, 3' x 15', 5' x 20', 5' x 35'
1—Traylor 4' x 40' rotary dryer
1—Western Precipitation Corp. S.S. pilot plant spray dryer, Type N-2
1—Bowen SS pilot plant spray dryer

FILTERS

3—Dorrco rubber covered filters, 6' x 2'
12—Sweetland #12 filters with 72 SS leaves
1—Niagara SS filter, Model 510-28
1—Oliver type 316 SS rotary vacuum filter, 4' x 5'
1—Oliver horizontal filter, 3'
1—GATX SS pilot plant filter, 2' x 6"
10—Shriver plate and frame filter presses, 12" x 42"
1—Shriver aluminum 30" x 30" P&F filter press, 30 chambers

CENTRIFUGES

7—Western States 40" type 316 SS suspended type centrifuges complete with perforated baskets, plows and 40 HP motors. Year built 1953
1—AT&M 48" SS suspended type centrifuge, complete with plow, motor and imperforate basket
1—Fletcher 48" center slung SS centrifuge, complete with perforate basket and motor

THE GELB GIRL—SEPTEMBER 1960

4—Tolhurst 40" center slung rubber covered centrifuges, with perforate baskets and motors
2—Fletcher 40" center slung rubber covered centrifuges with perforate baskets and motors

MIXERS

1—Cleveland SS double cone blender, 85 cu. ft. complete with drive and motor
2—Sturtevant #7 dustite rotary batch blenders, NEW
15—Robinson type 304 SS horizontal blenders, 255 cu. ft.
1—Baker Perkins Size 20, 2000 gal. double arm jacketed vacuum mixer with double naben blades
1—Baker Perkins Size 16, Type UUEM, 150 gal. jacketed double arm dispersion type mixer, complete with compression cover and 100 HP motor
2—Baker Perkins 20 gal. SS. jacket vacuum double arm mixers
1—Baker Perkins Size 4, laboratory mixer, sigma blades, 1 gal. total capacity
1—Banbury #1 mixer, chrome plate rotors, with 50 HP motor
1—Stokes SS granulating mixer, Model 21 J

MISCELLANEOUS

1—Vulcan SS bubble cap column, 4' x 25 plates
1—Badger type 316 SS bubble cap column, 42" dia. with 11 trays
1—Badger type 316 SS bubble cap column, 36" dia. with 8 trays
1—Struthers Wells type 316 SS heat exchanger, 330 sqft.
1—Condenser Service type 316 SS heat exchanger, 350 sq. ft.
3—Badger type 316 SS heat exchangers, 500 and 600 sq. ft.
1—Downington type 316 SS heat exchanger, 750 sq. ft.
2—Swenson type 316 SS vacuum crystallizer, 3'6"x12', 2'x12'
3—Williams type 316 SS hammermills, Model AK
1—Sprout Waldron Model 501-D pelleter
1—Ross 6" x 14", 3 roll paint mill, complete
1—Stokes #412F vacuum pump, complete

2—2000 gal. type 304 SS vertical storage tanks
1—Richmond Engineering type 316 SS 40 cu. ft. horizontal double ribbon blender
1—Oliver stainless steel rotary pressure precoat filter, 5'3" x 8'
4—Davis Engineering Carpenter 20 heat exchangers, 125 sq. ft., NEW

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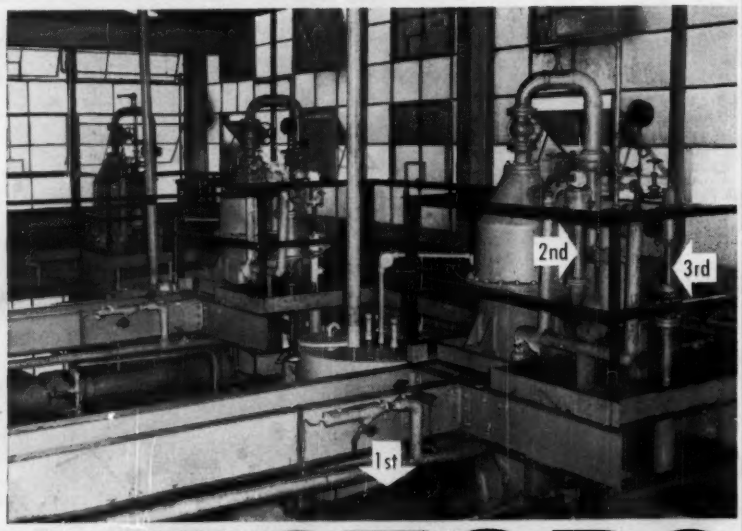

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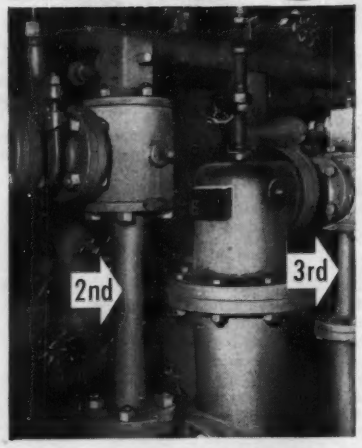

maintain low absolute pressure... help food processors remove objectionable odors and tastes

Three Elliott 3-stage steam jet ejectors, seen in upper photo, are serving deodorizers in a new food processing plant in Illinois. Two of the first-stage ejectors discharge to large Elliott barometric intercondensers which are served by two-stage ejectors. Photo at lower left shows close-up of second- and third-stage ejectors in deodorizer service.

Deodorization is made possible since neutral fat cannot be vaporized, but the components of oil which impart unpleasant odors and flavors can be changed into vapors through steam distillation. This steam flowing through the oil acts as a carrier, sweeping the vapors out of the oil. Key to the process is creating low absolute pressure—accomplished by Elliott steam jet ejectors.

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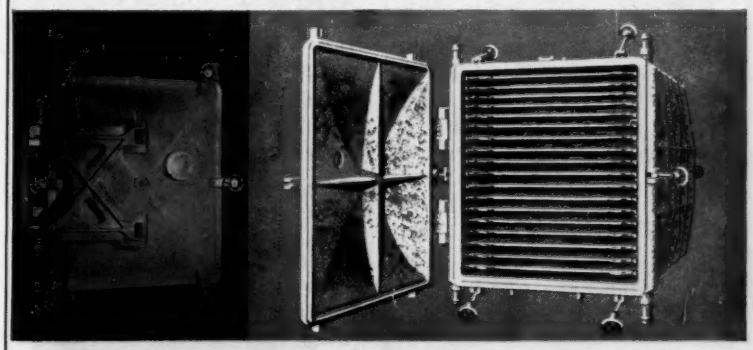

Phenolic resin-lined double door chamber dryer designed to process heat-sensitive chemicals..

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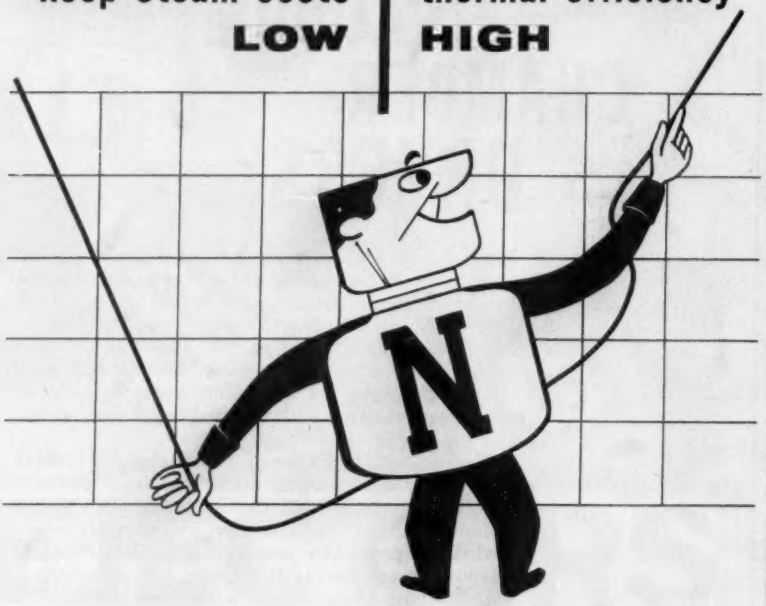

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Sure, some traps cost less than Nicholson . . . but the 'savings' exist only on the invoice. In actual use, some other traps can cost you three or four times their price in annual steam waste. Be sure to weigh cost against value when *you* buy steam traps. Specify Nicholson Thermostatic Steam Traps on your lines and equipment.

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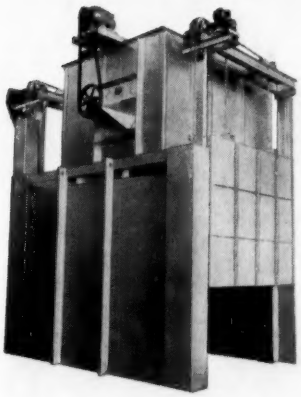
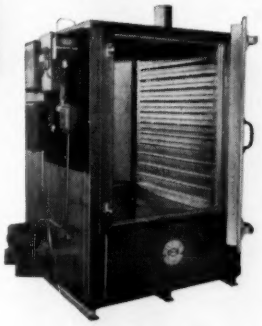


Truck oven, doors at both ends; for sintering ores at 1200°F. Air from external gas-fired heater is directed by recirculating fan through louvers across the work load. Stainless steel interior withstands corrosive vapors.



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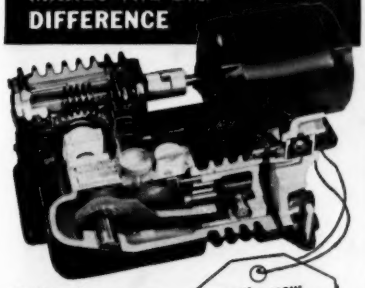

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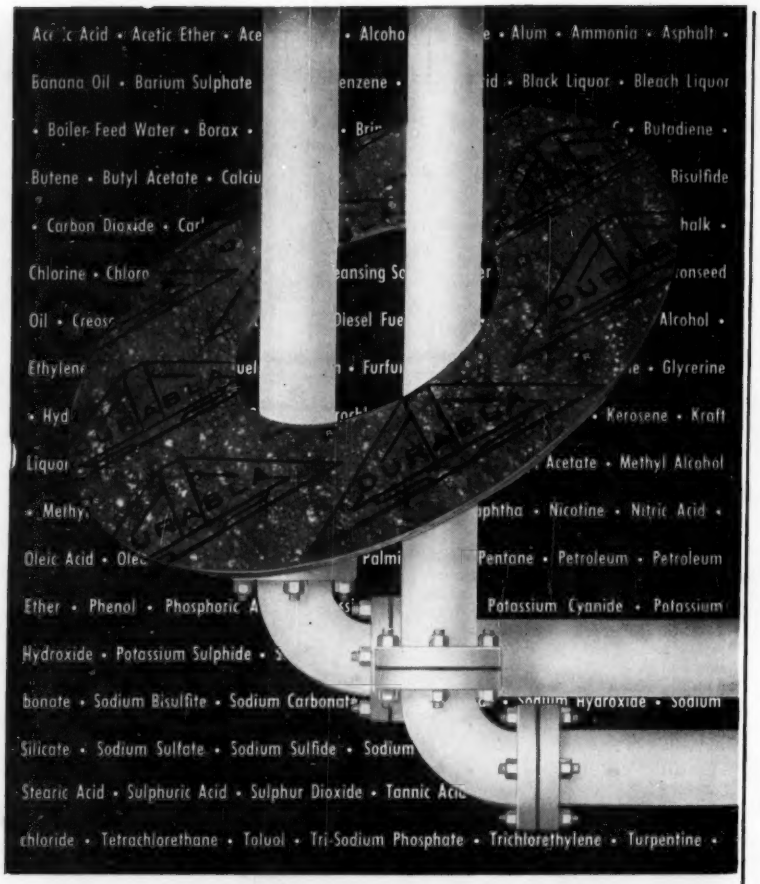
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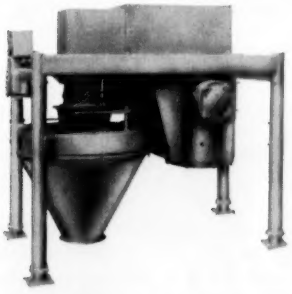

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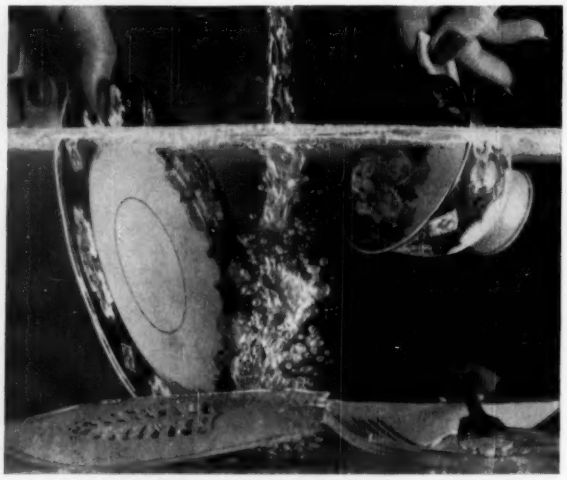

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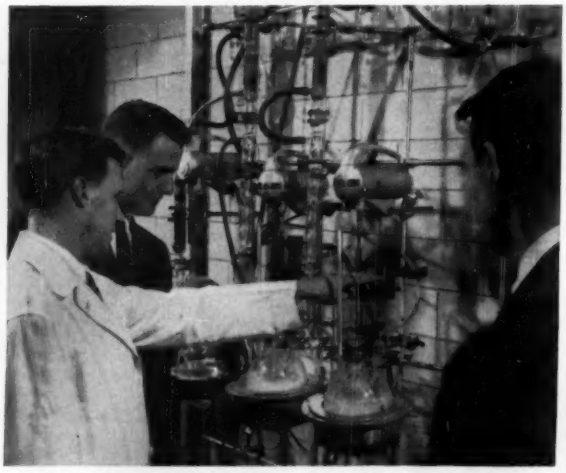

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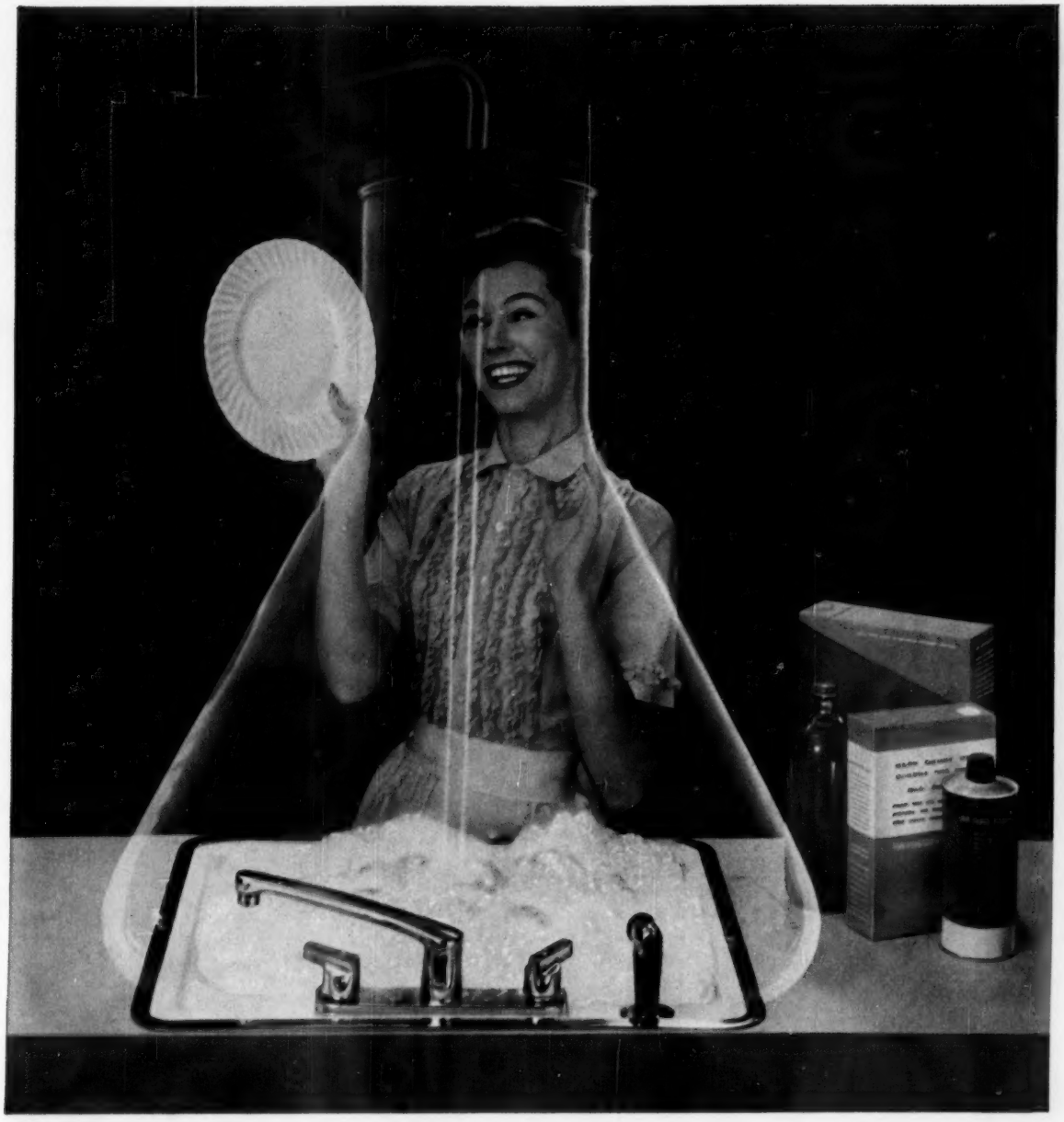

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